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THE DEPARTMENT OF DEFENSE SHALE OIL TASK FORCE. VOLUME I.(U)
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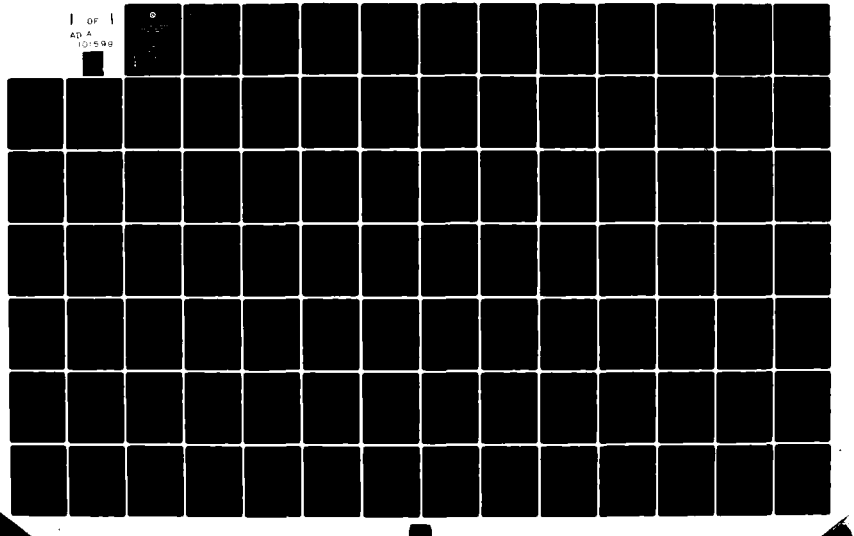


THE DEPARTMENT OF DEFENSE SHALE OIL TASK FORCE. Volume I.

FINAL REPORT. Dec 77 - Jun 78

Dr. Ruth M. Davis, Chair
Deputy Under Secretary of Defense

Mr. George Marienthal, Deputy Chair
Deputy Assistant Secretary of Defense

Dr. George Gemelos, Executive Secretary
Assistant to Deputy Under Secretary of Defense

5 October 1978

OFFICE OF THE UNDER SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

RESEARCH AND
ENGINEERING

5 OCT 1978

MEMORANDUM FOR THE DEPUTY SECRETARY OF DEFENSE

SUBJECT: Final Report of the DoD Shale Oil Task Force

I am pleased to submit the final report of the DoD Shale Oil Task Force. The work of the Task Force was initiated at the request of the DoD Shale Oil Policy Steering Group: it commenced in December 1977 and was completed in June 1978.

The Task Force has concluded that Department of Defense planning assumes that liquid hydrocarbon fuels will power its mobile platforms systems and equipment for the foreseeable future. Accordingly, based on projections of limited supplies of petroleum products for defense, and of increased U.S. dependency on imports, our report stresses the need for the Department of Defense to plan for an orderly transition from natural crude to synthetic fuels during the time period 1985-2010. The report also points out that shale-derived military mobility fuel is an attractive near-term alternate to natural crude oil.

In the report we have reviewed pertinent petroleum production and consumption trends; discusssed DoD's role in selecting and developing synthetic fuel alternatives to natural crude; and described ongoing and potential developmental efforts that Defense can appropriately pursue. We have also provided the skeletal framework of a Defense Mobility Fuels Action Plan that assigns specific functional responsibilities for synthetic fuels development. Your approval of this approach and suggested assignments of responsibility is requested to charter subsequent staff and Service actions.

With your concurrence, I will disband the DoD Shale Oil Task Force upon your acceptance of this report and its proposed structure for a Defense Mobility Fuels Action Plan.

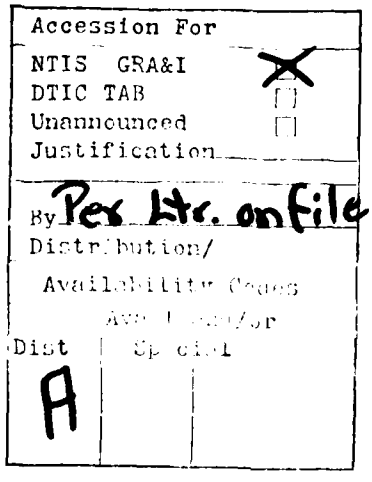
Ruth M Davis

Ruth M. Davis
Chairperson
DoD Shale Oil Task Force

Attachment

"There is no more serious threat to the long-term security of the United States and to its Allies than that which stems from the growing deficiency of secure and assured energy resources."

Secretary of Defense
Harold Brown
May 1977
House Ad Hoc Committee on Energy



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ACKNOWLEDGMENT

This report has been produced through the combined efforts of the Office of the Secretary of Defense and the Office of the Secretaries of the Army, Navy, and Air Force. Special thanks go to the members of the Shale Oil Task Force and the following individuals who made significant contributions in preparing the final report:

Mr. Walter C. Christensen
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Dr. Alan Roberts
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ABSTRACT

This two volume report summarizes the activities of the DoD Shale Oil Task Force. The work commenced in December 1977 and was completed in June 1978.

The research described in Volume I of the report explores the future availability of mobility fuels to DoD and addresses the options DoD has to ensure that its mobility fuel needs are satisfied. Volume I of the report contains: a review of pertinent petroleum production and consumption trends; projections of DoD's future requirements; and a recommendation that DoD must plan for an orderly transition from natural crude to synthetic fuels during the time period 1985-2010. The report also points out that shale-derived military mobility fuel is an attractive near-term alternative to natural crude oil. Volume I concludes by providing a skeletal framework of a Defense Mobility Fuels Action Plan which includes a suggested management structure and assignment of specific tasks.

Volume II of the report contains appendices which provide backup material to the report.

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EXECUTIVE SUMMARY

On 17 December 1977 the Deputy Secretary of Defense established the Defense Shale Oil Task Force, an informal group, and tasked it to address and make recommendations on the alternatives available to DoD to meet its mobility fuel requirements in the 1990's and beyond.

The primary objective of the Task Force was to address the potential use of shale oil as a synthetic fuel to be used by DoD as an alternative to crude-oil based fuels. In so doing the Task Force addressed:

- o The technical uncertainties attendant upon shale oil exploitation.
- o Synthetic fuel alternatives to shale oil with emphasis on comparative economics, environmental and timing considerations.
- o Industrial considerations.
- o Research and development on new propulsion systems and other modifications to mobile equipment needed for the use of alternative fuels or other than liquid fuels.
- o The related roles of DoD and DoE with emphasis on DoD needs for DoE support.

To accommplish its assigned task, the Task Force concentrated its effort on developing the following:

- o A compilation of credible and validated supply/demand data for DoD in the next 25-50 years.
- o A DoD strategy for maximizing the probability that liquid hydrocarbon fuels will be available as required.
- o A delineation of technical uncertainties associated with shale oil exploitation.
- o A set of synthetic fuel alternatives to shale oil illustrated by comparative economic, environmental and timing data.
- o A discussion of the role of industry in the commercialization of shale oil or other synthetic fuels.

- o Needed research and development activities related to the use of alternative fuels.

- o A listing of characteristics and required testing of synthetic fuels for DoD mobility use.

- o An agreed-upon DoD/DoE relationship in energy policy and energy developments for DoD mobility needs.

A discussion of these items constitutes the substance of the Report of the Defense Shale Oil Task Force.

After careful and detailed consideration of the topics listed above, the Task Force reached the following conclusions:

- o Significant shortages of petroleum fuels for U.S. needs will probably occur in the late 1980's and 1990's.

- o U.S. dependency on foreign sources is not likely to decrease in the near term.

- o DoD almost totally depends on petroleum or substitute liquid hydrocarbon fuels to meet its mobility energy requirements for the foreseeable future.

- o DoD presently has only two means of obtaining priority among U.S. users for its fuel supplies: namely;

  - The Defense Production Act.
  - Allocation under the Emergency Petroleum Allocation Act of 1973 (which runs out in 1978).

- o There is considerable uncertainty associated with any reliance by DoD upon these Acts.

- o DoD has no assurance that its mobility liquified hydrocarbon fuel requirements can be satisfied from known sources of natural crude petroleum.

- o Fulfillment of DoD peacetime readiness needs through a system of emergency allocation priorities of the Defense Production Act at the expense of other segments of the national economy is expected to be unacceptable.

- o DoD must plan on an orderly transition from natural to synthetic crude oil products and other fuels in the time period (1985-2010) to ensure that its mobility fuel needs can be satisfied through greater reliance on developable domestic sources.

- Shale-derived fuels are considered a most attractive alternative for military mobility needs.

Based upon the findings listed above the Task Force recommends that DoD develop a comprehensive Mobility Fuels Action Plan. This plan should include the following elements:

- A secretarial level Memorandum of Understanding to formalize DoD and DoE cooperative efforts to develop domestic sources of synthetic mobility fuels to meet DoD requirements.
- A briefing by the Secretary of Defense and the Secretary of Energy to the President concerning the cooperative DoD/DoE efforts in developing synthetic mobility fuel supplies.
- A technical and operational plan for DoD to transition from the use of conventional fuels to synthetic mobility fuels in the period 1985-2010.
- An accelerated DoD engine/fuel technology program to establish acceptable synthetic fuel specifications and to develop the engine technology to utilize a broad range of synthetic fuels.
- A DoD program to test and evaluate synthetic fuels produced from new sources.
- A DoD plan to provide an agreed-upon market for synthetic fuels, if appropriate.
- A high DoD priority for the development of the engine/fuels technology industrial base to enable the DoD to consume shale-derived oil substitutes as a primary source of defense mobility fuels.

The management of DoD's mobility fuels programs will require increased management attention. The Task Force recommends the following:

- The Defense Shale Oil Policy Steering Group will be disbanded. However, the Deputy Secretary of Defense will continue to be the approving authority for major policy matters related to the Defense Mobility Fuels Program, and have available for consultation the members of the disbanded Policy Steering Group with additional representation from ASD(PA&E) and ASD(ISA).
- The Chairman, Joint Chiefs of Staff will provide an annual update of DoD's current and projected 10 year mobility fuel requirements. This statement of requirements will include an

assessment of DoD's ability to secure adequate supplies for peacetime operation and to sustain adequate war reserve inventory.

- The Under Secretary of Defense for Research and Engineering will be responsible for proposing policy for all internal DoD and interagency matters relating to mobility fuels RDT&E.

- The Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) will be responsible for proposing policy and programs on matters pertaining to logistical, fuel allocation and regulatory matters (to include the establishment of DoD as a market for synthetic fuels, if appropriate.) The ASD(MRA&L) will serve as the primary focal point with the Department of Energy for matters relating to Defense mobility fuel requirements.

The above responsibilities will be carried out by the cited officials according to their instructions. The DoD Shale Oil Task Force suggests the use of the following existing and newly created working group structure which is designed to facilitate management and performance of assigned tasks in an efficient and timely manner while preserving the functional prerogatives of the participants.

- The Defense Energy Policy Council (DEPC) should be responsible for proposing policy and programs on matters pertaining to logistical, fuel allocation, and regulatory matters to include establishment of DoD as a market for synthetic fuels, if appropriate.

- The Defense Energy Action Group (DEAG) should plan and coordinate DoD-wide mobility fuels efforts pertaining to operational fuel allocation, and regulatory matters.

- The Deputy Under Secretary of Defense for Acquisition Policy should establish synthetic fuel specifications, and review the acquisition of new weapons systems for fuel compatibility with supply (DSARC interface).

- A Defense Mobility Fuels RDT&E Policy Council, chaired by the Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology) (DUSDRE(R&AT)) should be established which will be responsible for proposing policy for all internal DoD and interagency matters relating to mobility fuels RDT&E.

- A Defense Mobility Fuels RDT&E Action Group, chaired by the Assistant for Research to the DUSDRE(R&AT), should be established to develop plans for, and to coordinate, all DoD RDT&E efforts for mobility fuels. The Defense Synthetic Fuels Steering Group (DSFSG) should be disbanded and superceded by the new Action Group.

- The Defense Mobility Fuels RDT&E Action Group should:

- (a) establish working groups, as required, to perform program planning and coordination tasks

  (b) establish mechanisms to ensure adequate information exchange and preclude unwarranted duplication of efforts

  (c) assign the task of procuring test quantities of fuels for RDT&E programs

  (d) inform for prime-mover development and acquisition activities of implications for their future efforts that are derived from mobility fuels RDT&E program activities

  (e) report to the Defense Mobility Fuels R&D Policy Council by 30 November with a coordinated assignment for lead DoD component responsibility for mobility fuels technology

- After program plans have been developed and approved, tasks to be performed by individual Services and agencies should be funded and managed through normal channels.

CHAPTER 1

INTRODUCTION

The Department of Defense (DoD) is heavily reliant upon liquid petroleum products. DoD is the largest single U.S. energy consumer and accounts for about three percent of the national energy consumption through direct usage and an approximately equal amount through defense related industries. In wartime, these energy requirements would increase by more than a factor of three.

DoD's current total mobility fuel requirements are about 400,000 barrels per day.

Looking to the foreseeable future, there appears to be little relief from DoD dependence upon petroleum fuels. DoD continues to build mobile systems that are powered with petroleum based products. With a normal R&D cycle in propulsion programs of about 20 years from basic research to initial operational capability, it is clear that DoD will continue to be dependent upon liquid hydrocarbon fuels into the next century.

The nation's recoverable fossil energy resources are sizable. U.S. deposits of coal and oil shale contain more recoverable hydrocarbons than the world's total proven petroleum reserves. Properly developed, our domestic fossil energy resources could support national requirements long enough to allow for the orderly development and shift to renewable energy sources.

The central energy issue with which DoD must contend is that of guaranteeing adequate supplies of mobility fuels for U.S. defense

operations at home and abroad under peacetime and wartime conditions. Accordingly, the development of a domestic synthetic fuels industry is vitally important to the Nation's defense efforts.

Extensive synthetic fuels R&D and demonstration programs are currently being pursued by the Department of Energy (DoE). DoD's primary objective is to develop the capability to utilize, and become an informed customer for, the products of the emerging domestic synthetic fuels industry as soon as they are commercially available. The following are examples of typical tasks which should be pursued by appropriate elements of DoD to achieve this overall objective:

- o Conduct R&D to develop multi-fuel compatible with synthetic fuels.
- o Conduct R&D to develop propulsion systems for non-conventional fuels.
- o Develop specifications to guide alternative fuels development by DoE.
- o Investigate the logistics requirements for worldwide use of new fuels by the military, and
- o Develop contingency planning for transition from conventional fuels to synthetic liquid hydrocarbon mobility fuels.

The two most abundant sources of synthetic fuels -- coal and oil shale -- offer a great potential for relieving our dependence upon natural crude oil. The technology for producing liquid fuels from oil shale leads that of coal and both are signficantly ahead of technologies associated with other alternative sources, such as hydrogen, biomass, and solar.

DoD thus must continue to emphasize its responsibility to ensure an adequate supply of synthetic fuels for military needs and the availability of the technology to effect the best possible use of synthetic fuels in military mobile systems.

CHAPTER 2

TASK FORCE ACTIVITIES

2.1 BACKGROUND

A meeting* was called on 17 December, 1977 by the Deputy Secretary of Defense with the objective of determining what actions are to be pursued by OSD/DoD in meeting future DoD needs for mobility synthetic fuels. The following course of action was agreed to at the meeting:

- o A DoD Shale Oil Policy Steering Group was set up. The following attendees constituted the membership:

--	Mr. Charles W. Duncan	- Deputy Secretary of Defense
--	Dr. William J. Perry	- Under Secretary of Defense for Research and Engineering
--	Dr. Gerald P. Dinneen	- Principal Deputy and Assistant Secretary of Defense(C^3I)
--	LTG W. W. Vaughan	- Director, Defense Logistics Agency
--	Dr. John P. White	- Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics)
--	Dr. Percy Pierre	- Assistant Secretary of the Army (Research, Development and Acquisition)
--	Dr. David Mann	- Assistant Secretary of the Navy (Research, Engineering and Systems)

*The meeting was stimulated in part by the JCS Briefing of 7 December, 1977 (Appendix A)

-- Dr. John J. Martin - Assistant Secretary of the Air Force (Research, Development and Logistics)

-- Dr. Ruth M. Davis - Deputy Under Secretary of Defense (Research and Advanced Technology)

-- Mr. Dale Church - Deputy Under Secretary of Defense (Acquisition Policy)

-- Mr. George Marienthal - Deputy Assistant Secretary of Defense (Energy, Environment and Safety)

o A DoD Shale Oil Task Force on Developmental, Procurement, Economic and Industrial Aspects of Shale Oil Exploitations was established. The Task Force was asked to examine the alternatives available to DoD in meeting its synthetic fuel requirements in the 1990's and beyond with emphasis on shale oil and its comparative advantages and disadvantages.

o The primary objective of the Task Force was to address the potential use of shale oil as a synthetic fuel to be used by DoD as an alternative to petroleum based fuels. In so doing, the Task Force would address:

-- The technical uncertainties attendant upon shale oil exploitation.

-- Alternatives to shale oil for synthetic fuels with emphasis on comparative economic, environmental and timing considerations.

-- Industrial considerations.

-- Research and Development on new propulsion systems, and other mobile equipment modifications to permit the efficient use of alternative fuels or other than liquid fuels.

-- The mutually interdependent roles of DoD and DoE with emphasis on achievement of DoD needs with DOE support.

The Task Force held its organizational meeting on 28 December, 1977. Subsequently, a Charter (Attachment 1) was drafted and approved by the group and individual preliminary assignments were made according to the charter objectives.

Formal contacts with DoE commenced on 23 December, 1977, and action officers were appointed in each department to continue departmental coordination. Department of Energy nominated Assistant Secretary of Energy for Energy Technology, Dr. Robert Thorne, and Department of Defense nominated Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology), Dr. Ruth M. Davis.

The first milestone was attained when the group made its initial report to the Steering Committee on 30 January, 1978 (Appendix B). In that briefing the Task Force focused its work on the following areas:

- o The compilation of credible and validated supply/demand data for DoD in the next 25-50 years.
- o DoD strategy for maximizing the probability that liquid hydrocarbon fuels will be available as required.
- o Technical uncertainties associated with shale oil exploitation.
- o Alternatives to shale oil with emphasis on comparative economic, environmental and timing considerations.
- o The industrial role and considerations.
- o Research and Development activities related to the use of alternative fuels.
- o Characteristics and testing of synthetic fuels for DoD mobility use.
- o DoD/DoE relationships on energy and joint policies.

The approach taken by the Task Force was based on the following set of assumptions:

- o DoD energy demands to meet its mobility requirements should be a prime determinant of national energy policy.
- o DoE energy supply data will provide the basis for matching DoD demand to supply: We recognized the DoE supply data

for the 25-50 year time span is necessarily soft, while DoD demand data is fairly hard since it is based on data collected over the last five years and on Service-documented projections.

- o Current DoD R&D programs on vehicular propulsion are based on liquid hydrocarbon fuel availability.
- o The propulsion R&D cycle is typically 20 years (basic reseach to initial operational capability), thus, DoD's mobility needs for the next 25 years are dependent upon the availability of liquid hydrocarbon fuels.

The Task Force's report to the Steering Group consisted of the following topics:

- o Relevant supply/demand data.
- o Technical aspects of shale oil exploitation.
- o Alternatives to liquid hydrocarbon sources for DoD.
- o Industrial activities and roles in shale oil production.
- o Relevant R&D activities.
- o Scenario for Action.

The last topic included a detailed Scenario for Action Plan that was approved by the Steering Committee and subsequently formalized by the Deputy Secretary of Defense in a 23 March 1978 Action Memorandum (attachment 2) issued to Secretaries of the Military Services, the Under Secretary of Defense for Research and Engineering and the Director of Defense Logistics Agency.

In that memorandum, the Deputy Secretary of Defense restated his belief that the Task Force's activities are vital to the future well-being of national security in all situations and require immediate and concentrated attention. The memorandum further states that the Secretary of Defense concurs in this matter and has endorsed the proposed

course of action. DoD offices received specific action items that were outlined in the Task Forces's Scenario for Action Plan. Those assignments constitute the basis of this final report.

Part of the Task Force's review of the industrial considerations of shale oil was conducted at an 18 April 1978 meeting at Denver, Colorado, sponsored by the Rocky Mountain Oil and Gas Association. Thirty-three different companies were represented at the one day oil shale commercialization strategy meeting. Attending were: DoD, DoE Shale Oil Industry, and United States Geological Survey representatives as well as state and local officials. The conclusion of that meeting can be summarized by stating that commercialization of oil shale can be realized by mid-1980's if priority is given to:

(1) oil shale technology development needs

(2) overcoming institutional and environmental barriers

(3) providing financial incentives for meeting Federal Government shale oil production goals, and

(4) access to petroleum deposits

2.2 A PROJECTION OF CRUDE OIL SUPPLY AND CONSUMPTION WITH IMPLICATIONS FOR NATIONAL DEFENSE

The Task Force reviewed projections of world recoverable reserves of natural crude oil and estimated the impact of limited supplies on national defense. This section describes our review of production and consumption projections from government and industrial sources and projects defense mobility fuel requirements for peacetime and wartime.

Based on these projections, we have estimated the potential impact of increasing economic and political pressures to reduce defense

consumption of petroleum as production reaches a peak and begins to decline. We have also examined the implications of declining petroleum supplies on our major allies.

Our review of world production and consumption forecasts involved no original research. Industrial and government literature and existing intelligence reports were the primary sources of data for this analysis. From these sources we have learned that among government and industrial analysts there is a general concensus on estimates of the total resources available and on forecasts of future production.

From these consensus projections, it is evident that recoverable petroleum resources cannot continue to support consumption growth trends established over the last quarter century. It is also evident that defense operations will be significantly affected as the production rate of natural crude first begins to grow more slowly and then begins to decline. The likely time period for the appearance of significant effects is roughly 1990-2005. By that time, natural crude production must be augmented by alternative sources of mobility fuels if we are to sustain the force structure and the force readiness necessary for national defense.

2.2.1 World Resources

Estimates of the total recoverable amount of natural crude have increased steadily until 1960. These increases were tied to an increased knowledge of the earth's geology and expanded drilling of known oil bearing formations. Since 1960, the range of estimates has narrowed and settled in the 2-2.5 trillion barrel range. These estimates are based on projected recovery technology and assume the extraction of

approximately 35-40 percent of the crude resource. It is unlikely that significant additions will be made to estimates of the total recoverable resource unless unexpected breakthroughs are achieved in recovery techniques.

2.2.2 Consumption Trends

Cumulative consumption of petroleum through 1976 totaled 340 billion barrels, about 15 percent of the total resource. World consumption has grown from about 4 billion barrels per year in 1950 to 22 billion barrels per year in 1976. This reflects an annual average growth rate from 1950 to 1973 of 7.5 percent slowing to an average of 1 percent between 1973 and 1976. Growth in 1977 returned to a 4.5 percent annual rate.

Growth rates for non-communist countries are somewhat lower, averaging 7.1 percent per year over the period 1950 through 1973, then dropping to near zero growth through 1976.

2.2.3 Production Forecasts

Production projections cannot, however, support consumption growth at the previously cited long-term rates. As the total amount of oil in the ground decreases, the real price will increase and production and consumption rates will first grow more slowly and then decrease in absolute amounts. A consensus of production forecasts shows world production peaking at slightly less than 40 billion barrels per year before the turn of the century. For the World Outside Communist Areas (WOCA), we portray a curve that peaks at about 25 billion barrels per year under the assumption the OPEC production reaches 45 million barrels per day. This assumption requires a Saudi Arabian production of 20

million barrels per day around 1990 compared to about 9 million barrels per day now. This rate is within the capacity of their fields should they choose to develop the required production capability but this expansion of capability may not be politically or economically acceptable to them.

Projected cumulative production is displayed in Figure 1 and shows how production is likely to be constrained as we approach the limit of recoverable world resources. The world and WOCA annual production functions implied by this situation and that form the basis for the analysis in this report, are shown in Figure 2.

From these forecasts, we conclude that production will probably peak before the turn of the century. We also conclude that historical growth patterns cannot be sustained.

2.2.4 U.S. Domestic Data

U.S. domestic production has passed its maximum by most estimates. Production peaked in 1970 at roughly 4.1 billion barrels per year and fell to about 3.7 billion barrels per year in 1977. During this time, domestic consumption grew to 6.7 billion barrels per year. The gap between domestic production and consumption has grown rapidly and imports have increased as depicted in Figure 3.

Projections by major U.S. oil companies indicated domestic production may reach 4.2 billion barrels per year by 1990 under assumptions of favorable government action on decontrol issues. Even with this somewhat optimistic projection, it is clear that growth in U.S. consumption of petroleum must be supported by imports or substitutes.

2.2.5 Defense Petroleum Requirements

Direct U.S. military consumption is only about 2.5 percent of total U.S. consumption. In fact, peacetime direct military consumption could be supported by less than 5 percent of 1977 domestic production. Nonetheless, the U.S. military is the largest single consumer in the U.S. marketplace.

FIGURE 1

CUMULATIVE WORLD CONSUMPTION/PRODUCTION
(TRILLIONS OF BARRELS)

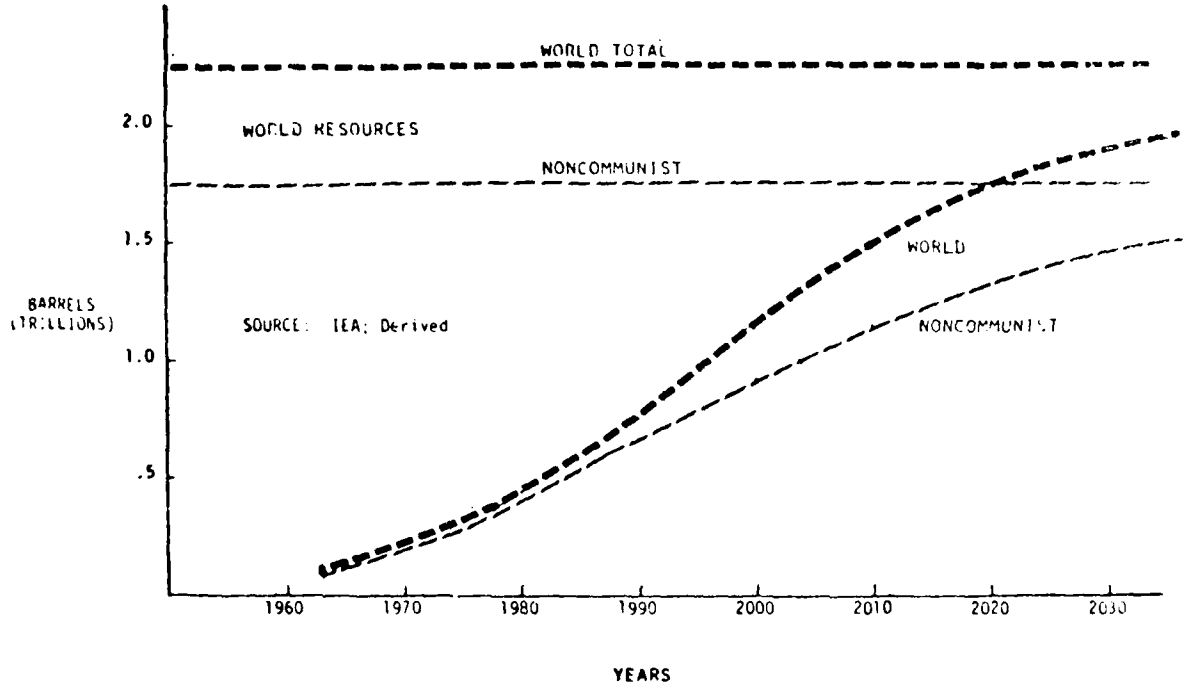


FIGURE 2

WORLD CONSUMPTION/PRODUCTION OF PETROLEUM
(BILLIONS OF BARRELS PER YEAR)

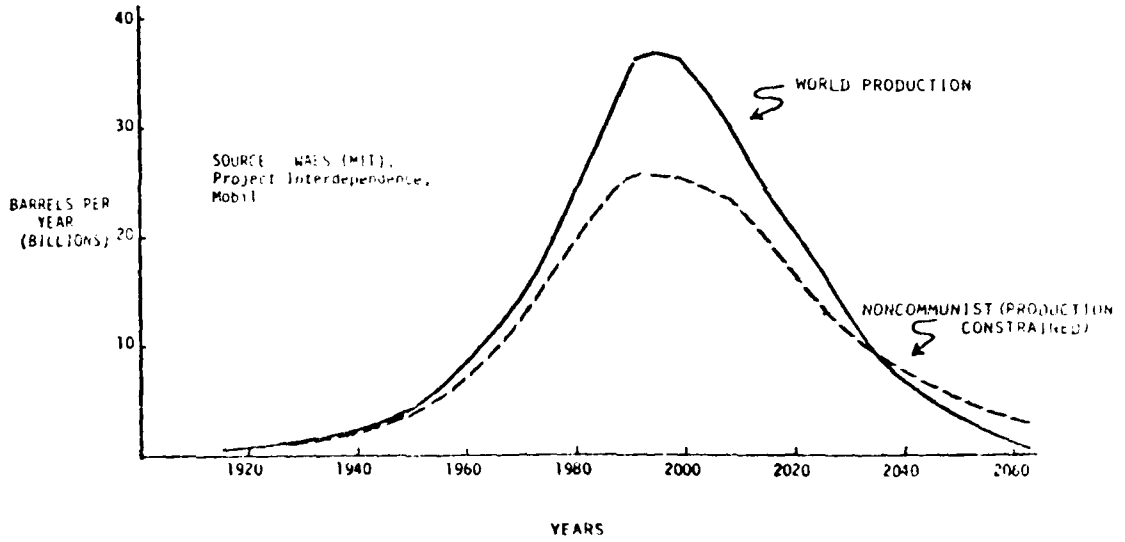
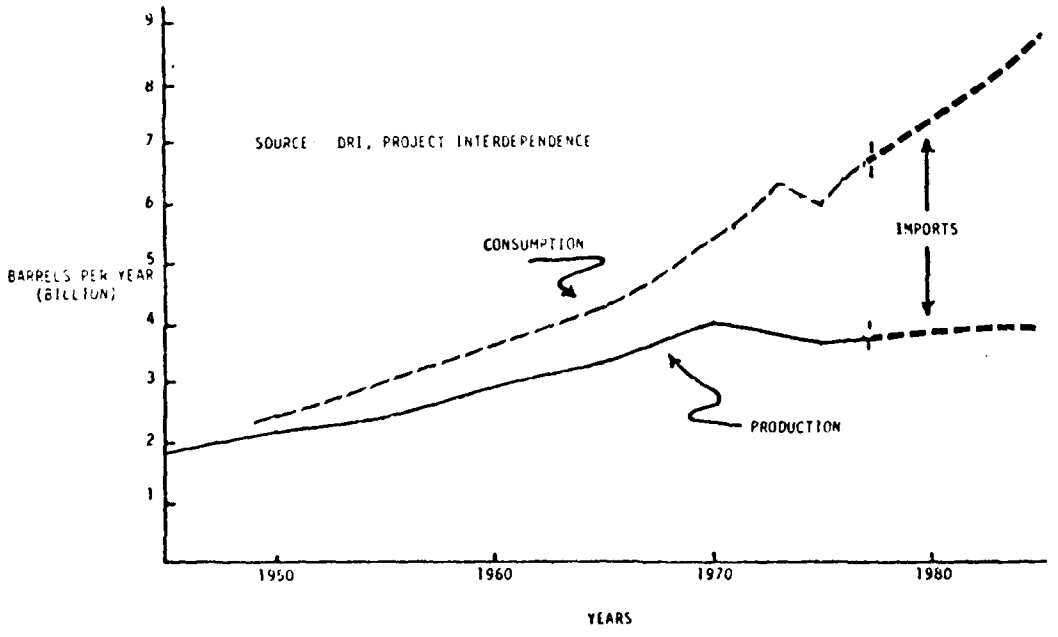


FIGURE 3

DOMESTIC PRODUCTION/CONSUMPTION
(BILLIONS OF BARRELS/YR)



Thus, military consumption will be subject to high visibility and to significant pressures to limit consumption when free world supplies become restricted and prices increase substantially.

In fiscal year 1977, defense consumption totaled about 175 million barrels. About 15 percent of this consumption was for power generation and heating of fixed facilities. The remainder was consumed by ships, aircraft and vehicles as a mobility fuel. These mobility fuels are displayed by product type in Table 1. It should be noted that the major portion of this defense mobility consumption, about 114 million barrels (75 percent), was jet fuels. Navy consumption of distillates was second at 23 million barrels (15 percent).

TABLE 1

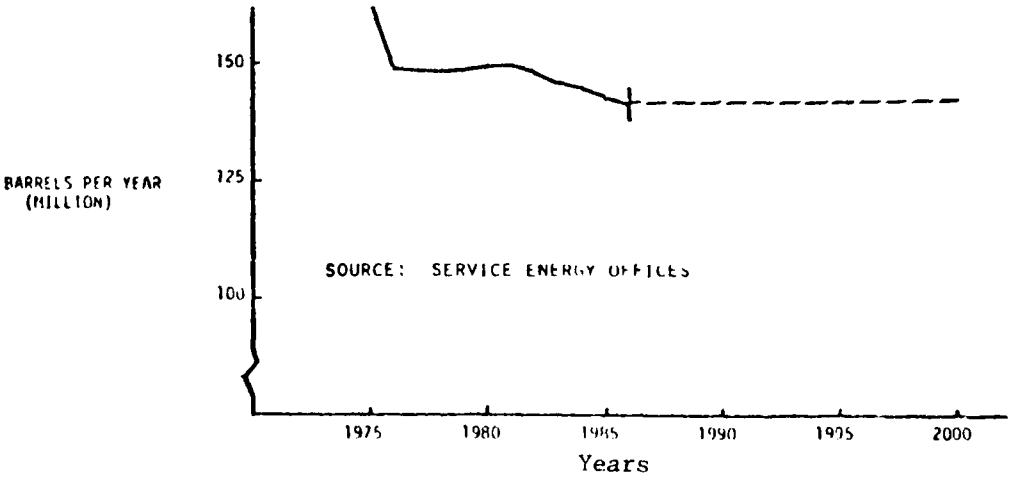
PEACETIME MOBILITY FUELS CONSUMPTION
FY 1977 (BBLS in 000)

	AF	ARMY	NAVY	OTHER	TOTALS
Jet Fuel	86,536	2,600	24,800	-	113,936
AVGAS	698	100	1,000	-	1,798
MOGAS	1,483	3,200	1,200	500	6,383
Distillates (less fuel oil)	1,038	2,500	22,700	700	26,938
TOTAL	89,755	8,400	49,700	1,200	149,055

Service projections of peacetime consumption through FY 86 show slight decreases in consumption. The decrease is attributable almost entirely to the Navy. Navy jet fuel consumption decreases result from increased use of simulator devices for training and improved efficiency in the next generation of aircraft engines. Projected decreases in ship distillates are attributed to programmed hull cleaning techniques and improved anti-fouling paints. Air Force programmed flying hour increases are offset by decreased consumption per flying hour so projected consumption remains relatively constant. These projections are summarized in Figure 4.

FIGURE 4

DEFENSE CONSUMPTION OF MOBILITY FUELS
(MILLIONS OF BARRELS PER YEAR)



We assume that by 1986 conservation measures and simulator usage will have succeeded in achieving the majority of attainable fuel savings that can be reasonably expected given existing technology. We also assume that force structure and activity rates will continue at currently programmed levels after 1986. Thus, we project DoD consumption after 1986 to remain constant.

To meet wartime military and industrial requirements, the U.S. could use major oil stocks from three categories. These are DoD owned stocks, industrial stocks and the federally owned Strategic Petroleum Reserve (SPR). War reserve stocks and the supply pipeline for peacetime operations would probably provide adequate stocks for at least the initial period of a major conflict.

U.S. industrial stocks are about 1,200 million barrels. At current consumption rates, this would provide 65 days of consumption without replenishment. However, about 30 days of stocks are needed for refinery feedstocks and to fill the transportation pipeline. Industrial stocks are therefore sufficient only for 35 days of normal peacetime consumption.

The SPR may have its currently authorized one billion barrels in place late in 1985. Fill rate milestones are:

Now in place	29.1 million barrels
End of 1978	125 million barrels
End of 1979	281 million barrels
End of 1980	500 million barrels
End of 1985	1000 million barrels

These stocks combined with domestic production would supply our requirements in most projected wars.

2.2.6 Implications for Defense

Although wartime consumption requirements are important for strategic planning, the total amount required is small compared to expected peacetime consumption over many years and could be supplied from our stockpiles. Moreover, in wartime, needed fuel would undoubtedly be provided by reallocating from other sectors. In peacetime, we cannot count on such a reallocation. Thus, the major impact of diminishing fuel supply on Defense would be on peacetime consumption.

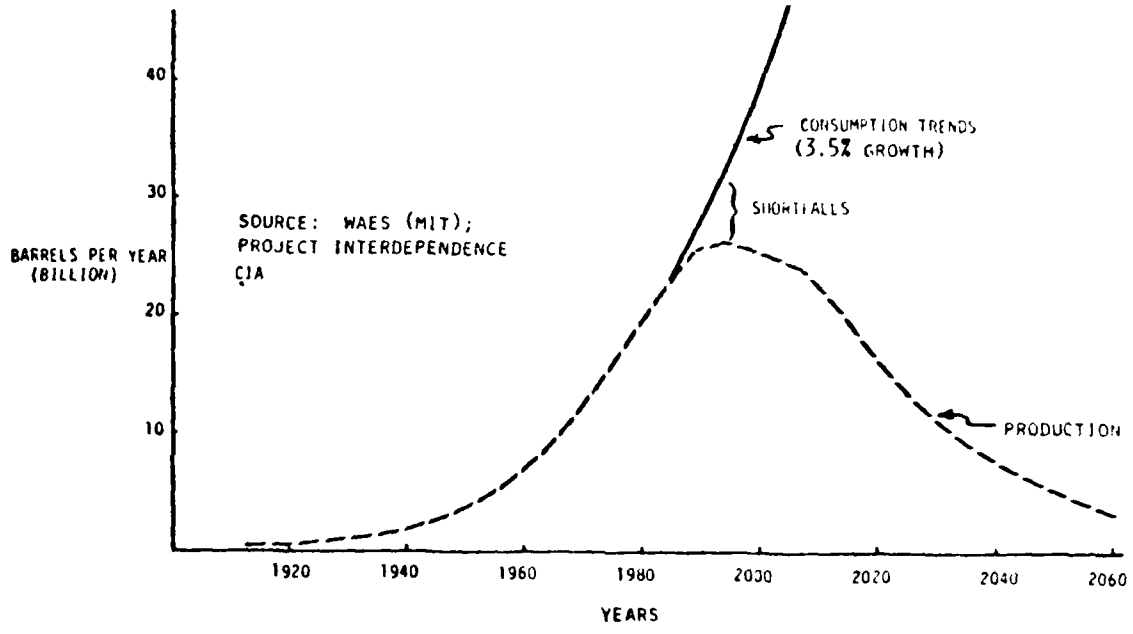
The amount of fuel available to Defense depends on several variables including the price of oil, size of the Defense budget, and possible preferential allocation schemes. These variables and their interaction are too complicated to project with any certainty. However, we can estimate when DoD might be significantly affected by attempting to relate effects on the overall economy to possible impacts on defense.

We anticipate that the pressure on defense might become intense when production can no longer support the historical trends in consumption growth (business as usual). At this point, the overall economy will have to begin to make major adjustments. We anticipate that higher prices and political pressure may force defense to reduce consumption at the same time the private sector has to adjust to lower economic growth rates and individuals adjust to lower rates of growth in overall economic standards of living. If we assume that defense

must bear a proportionate share of the shortfall between consumption trends based on past rates of growth and projected production (shown in Figure 5), we can anticipate major reductions in force levels or activity rates starting about 1990.*

FIGURE 5

NONCOMMUNIST WORLD PRODUCTION SHORTFALL
(BILLIONS OF BARRELS PER YEAR)



On the other hand, it is conceivable that Defense could continue to obtain the fuels it requires until petroleum production

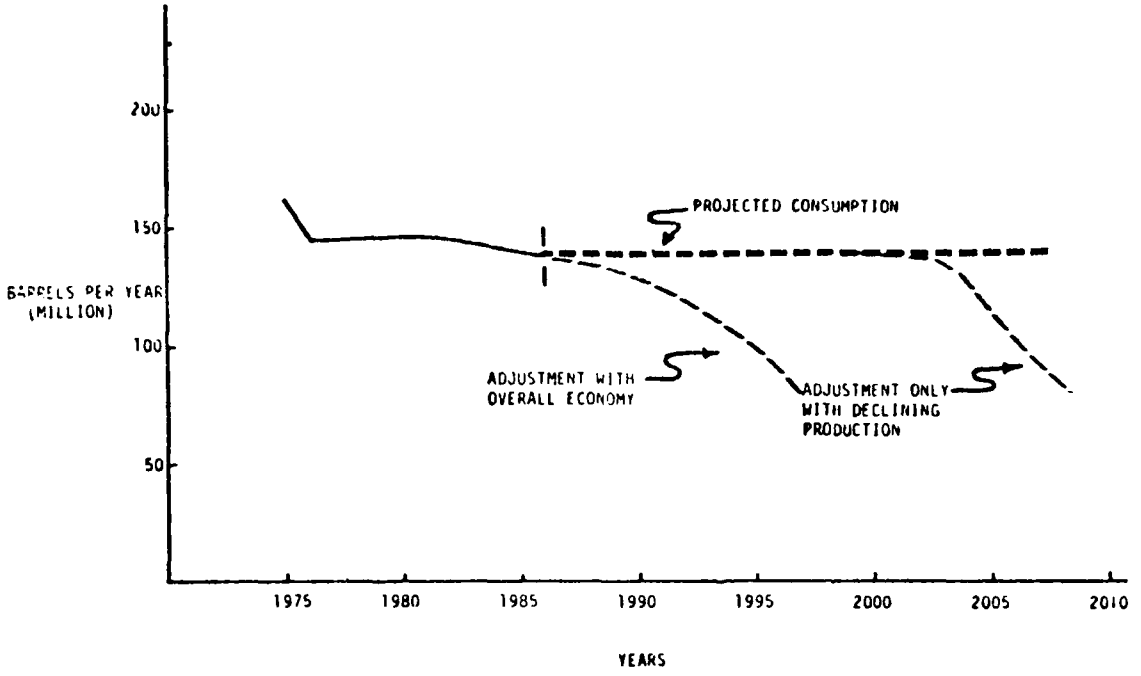
*The above conclusion is based on an analysis that assumed a maximum Saudi Arabian production rate of 20 million barrels per day. If Saudi Arabian production were held at its current level of 9 million barrels per day, then the same analysis would lead to a date of about 1985 for a significant impact on defense. However, it is likely that Saudi Arabia production will increase to at least 12-14 million barrels per day if not the full 20 million barrels per day.

peaked and began to fall. In this case, major impacts on Defense would be avoided until just after the turn of the century.

The possible impact on defense, based on these two scenarios, is shown in Figure 6 and suggests that the impact on Defense would occur in the 1990-2005 period.

FIGURE 6

POSSIBLE MOBILITY FUEL AVAILABILITY TO DOD
(MILLIONS OF BARRELS PER YEAR)



2.2.7 Implication for Major U.S. Allies

As world crude production declines, our European and Asian allies will be in much the same position as the United States. These countries will find it difficult to retain conventional patterns consumption in the face of declining supplies. The probable effect will be to reduce supplies for national defense in peacetime unless

alternative sources (syncrudes) or alternative technologies (hydrogen engines, etc.) are available.

Less information exists concerning the current and projected defense fuel requirements of our NATO and Japanese allies because this area has traditionally been left to each individual country and because their budgeting and planning tends to be fairly short range.

NATO (Europe) total consumption is about 9.7 million barrels per day or 50 percent that of the United States. NATO peacetime military consumption is about 20 percent of U.S. military peacetime consumption. NATO petroleum stocks of 964 million barrels are equal to about a 95 day supply at peacetime rates including transportation stocks and feedstocks.

The absolute level of stock available in wartime is scenario dependent. While reserves are widely dispersed throughout Western Europe, European procedures require oil companies and private industries to fund and hold reserves rather than relying on national strategic petroleum reserves. Large reserves are held near refineries and in above ground storage tanks and thus are highly vulnerable to attack.

Average Japanese oil consumption was 4.8 million barrels per day in 1976 or about 25 percent of U.S. domestic consumption. Peacetime defense consumption is approximately 0.3 percent of the national oil consumption or around 15 thousand barrels per day. Japan maintains 376 million barrels of reserve stocks or approximately 75 days worth at peacetime rates.

Both Japanese and NATO military consumption rates are lower than they were prior to the 1973 oil embargo. Our best information indicates that until the year 2000, peacetime military needs in Europe will remain relatively constant because major additions to the force structure are not anticipated. Japanese consumption could increase slightly if Japan removes the one percent of GNP ceiling on defense spending, -- a step not anticipated in the near future.

2.2.8 Conclusions

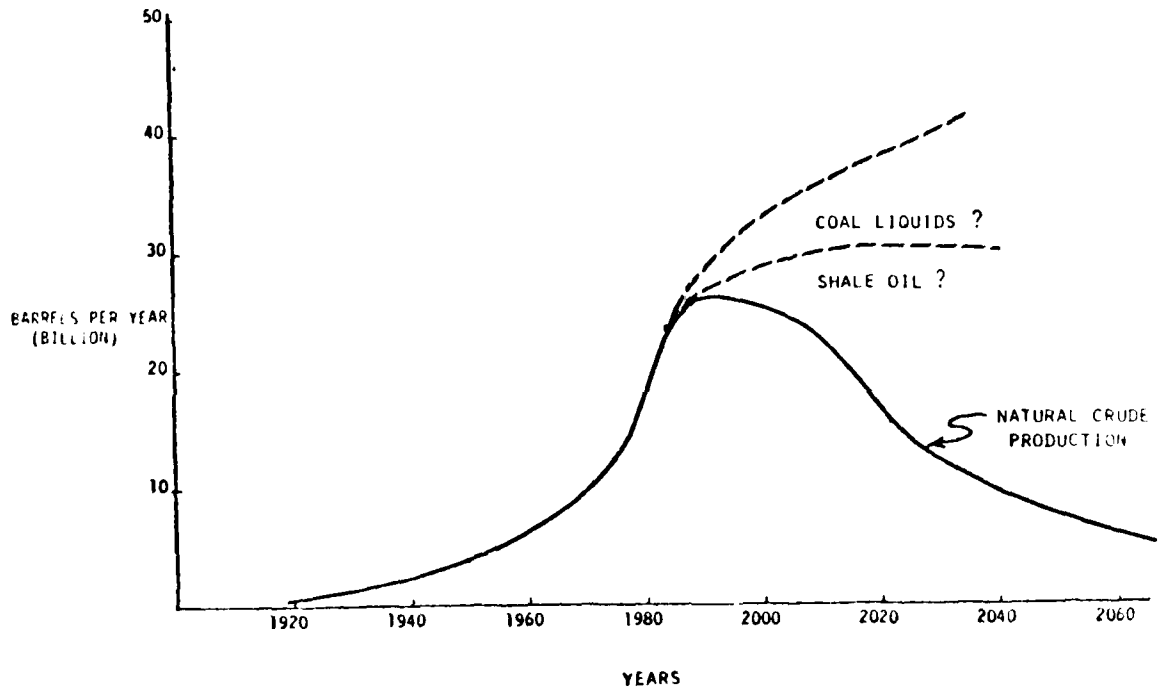
We conclude that all projections of impacts of petroleum shortages on defense are highly uncertain. National priorities, both in the United States and for major U.S. allies, may force policies that could dramatically alter the supplies of petroleum products available for defense from those depicted in Figure 6. Policies formulated by nations and organizations outside our traditional alliances could also significantly alter world supply projections. We can only conclude that the world resource is finite and, given projected recovery techniques, supplies of natural crude in the world marketplace will rise and then decrease significantly within the 25-50 year period studied by the Shale Oil Task Force. In order to have high confidence that sufficient mobility fuels will be available for Defense, alternatives must be developed and produced as depicted in Figure 7.

Conservation, expanded recovery techniques, increased user efficiency and new discoveries may delay the production decline but only for a short time. We believe, however, that these actions are important since they provide additional lead time for the development

of mobility fuels derived from alternative sources. DoD's role in developing and implementing a national energy policy containing syncrude production provisions is critical to assure continued ability to maintain our force levels and operating tempo at the level we believe necessary.

FIGURE 7

THE PRODUCTION OUTLOOK
(BILLIONS OF BARRELS)



2.3 ROLE OF DOD IN NATIONAL ENERGY POLICY

The DoD, as the Nation's largest single consumer of energy is profoundly impacted by national energy policy but ironically, DoD has historically had little influence in the formulation of that policy. This is not altogether surprising. DoD is a claimant of energy resources along with all other consumers in the economy. We are also a payer of bills for the energy we use. Decisions on allocation of fuels, deregulation of prices and the like are best left to those without the apparent conflict of interest.

DoD, however, is more than just a consumer of energy. We are the agency of the Federal Government charged with the military security of the United States. As such, we must be in a position to advise of the impact that proposed energy policies have on our missions. The current Administration's decision to double the size of the Strategic Petroleum Reserve from 500 million barrels to 1 billion barrels was due, at least in part, from concerns raised by the DoD. On the other hand, current Administration deliberations in the Department of Energy's National Energy Program (NEP-II), that address the crucial issues of energy supply during the post-1985 time frame, have been conducted without DoD participation.

This section of the report examines the impact and effectiveness of current policy and legislation as it bears upon our mobility fuels problem. This analysis, and those that follow lay the groundwork for actions that we must take to assure that our voice is an effective one in shaping the policies needed to minimize the dangers of disruption to DoD supplies of essential liquid hydrocarbon fuels.

Existing legislation that bears upon the mobility fuels problem can be divided into two categories: (1) legislation that deals with the stockpiling or allocation of natural petroleum fuels, and (2) legislation through which the Government can offer incentives for industry to develop alternative fuel sources. The principal statutes in these categories are listed below:

2.3.1 Stockpiling or Allocation of Natural Petroleum

2.3.1.1 Defense Production Act - Title I

Title I of the Act, "Priorities and Allocations", authorizes the President to require that performance under contracts deemed appropriate to promote the national defense take priority over other contracts.

Title I was used in 1973 when the DoD asked the Federal Energy Administration to invoke the production act to meet its petroleum needs. The Defense Fuels Supply Center requested this in May of 1973 (before the oil embargo). It was invoked in November of 1973, and initial deliveries began in the first quarter of 1974. Much of the delay was caused by the lack of existing procedures to apply the DPA to fuels. To correct that, in 1975, the DoD provided to FEA a draft regulation outlining required procedures. No action was taken by FEA on this.

In February 1978, we asked the Administrator of the Energy Regulatory Administration, who now has authority for such matters in the Department of Energy, to reopen this issue. He has done so, but there are continuing issues between DoD and DoE regarding pricing,

whether appeal procedures or "stay" provisions should be provided for suppliers and third parties, and our role in defining our own priorities.

2.3.1.2 Emergency Petroleum Allocation Act of 1973 (EPAA)

DoD obtained various petroleum products under this statute between 1974 and 1978. Mandatory allocation and price controls have been withdrawn gradually over the past several years and will be terminated this year. Work needs to be done to assure that procedures for reestablishing controls are current and can be invoked quickly. We also need to clearly define the circumstances under which the EPAA and the DPA can be utilized.

2.3.1.3 Energy Policy and Conservation Act of 1975

This Act authorized the establishment of a Strategic Petroleum Reserve (SPR) containing up to 1 billion barrels of petroleum. Assuming imports of about 10 million barrels per day, a 1 billion barrel SPR would offset the loss of all U.S. imports for 100 days. This coverage would in fact be longer lasting since it is unlikely that all imports would ever be denied, and in an embargo situation, energy conservation measures would be taken to reduce consumption.

Virtually all of the SPR petroleum is unrefined crude that would be fed to refineries under rules established by DoE. There is no special provision in the statute or implementing procedures to provide DoD priority access. The DoD would invoke Title I of the Defense Production Act, obtaining priority treatment from the refiners. The ability of refiners of DoD products to obtain the feedstock they need from the SPR presumably would derive from the mandate they have

been given under the DPA. Additional work is needed to clarify just how that would work and to estimate the certainty with which these arrangements could be successfully implemented.

In summary, legislation does exist to permit DoD to obtain petroleum products "off the top" in periods of scarcity; however, procedures for so doing need clarification. Issues exist between the DoD and DoE that will require negotiation before the procedures can be finalized. Even when this work is done, however, major uncertainties will remain about DoD obtaining needed supplies in peacetime. During periods of war, we can assume that the national defense effort may obtain priority. During peacetime, the DoD will be hard pressed to compete for energy resources with the other sectors of the national economy.

To a degree, the DoD must be prepared to share national scarcity. We can do that up to a point; however, there is a minimum level of training required if force readiness is to be maintained. This training, even when performed as austerely as possible consumes enormous quantities of fuel. It is difficult to convince the public of the need for continuing training when the fuel can be used to keep the commercial airlines on schedule and more factories open.

The DoD does not have the final decision on implementing any allocation mechanism. Ultimately, the President must make the difficult decision, and it may not be possible for him to provide DoD the fuels it needs after considering all aspects of the problem. Ironically, it is in a period of general fuel shortages when

the possibility of armed confrontation will probably increase. We would argue that the readiness of our forces should be increased as fuel supplies are curtailed.

2.3.2 Present Incentives to Industry for Alternative Fuels

2.3.2.1 Defense Production Act - Title III

Under this title, the President can allocate materials and facilities to promote the national defense.

Over the past three years the DoD has assisted the Federal Preparedness Agency in identifying industrial base deficiencies and developing proposals for alleviating those problems under Title III. For example, three DoD proposals have addressed means by which the U.S. could reduce its dependence on foreign sources for chromium. As a result, the Federal Preparedness Agency was appropriated $1.1 million in FY 1978 under Title III for the development of substitutes for chromium and the recovery of chromium from metallic waste materials.

Other proposals that were submitted by DoD to the Federal Preparedness Agency for FY 1979 that have characteristics similar to establishing a synthetic fuel source include (a) development of a 1.5 million pound per year U.S. capacity for ultrafine cobalt powder, (b) development of a 100 ton per day pilot plant for extracting cobalt and nickel from domestic low grade nickel lateritic ores and (c) development of magnesium as a substitute for aluminum.

In order to qualify for Title III funding, it is necessary for DoD/DoE to demonstrate that synthetic fuels produced from domestic oil shale are essential to fulfill military and/or

industrial base requirements in peacetime or during mobilization. The existing supply of petroleum, the feasibility of substitution, civilian austerity and conservation would have to be addressed.

The obvious shortcoming of Title III is its inextricable relationship to national defense. If it can be demonstrated that liquid fuels derived from oil shale are essential for national defense, the President can request appropriations from Congress under Title III. These appropriations could be used to guarantee loans (Section 301) and to make loans (Section 302) to private business enterprises for the expansion of capacity, the development of technological processes, or the production of liquid fuels from oil shale or other sources. The President can also request appropriations to purchase, or make commitments to purchase, liquid fuel produced from oil shale (Section 303).

As an alternative, the Executive Branch could press for legislation that would broaden Title III to include energy as an independent non-defense criterion as was done for Title I powers. However, this would further dilute the effectiveness of the Act for direct defense programs. It could also be argued that broadening Title III would detract from its original intent and purpose of providing resources for the national security.

2.3.2.2 Department of Energy Act of 1978, Civilian Applications - P.L. 95-238 - Title II

The Department of Energy Act of 1978, Civilian Applications (P.L. 95-238 -- February 25, 1978) that authorizes appropriations for the Department of Energy (DoE) for FY 1978 provides for

a loan guarantee program for alternative fuel demonstration facilities and requires that a study be conducted of the purchase by the Federal Government of products from such facilities. Title II specifically authorizes the Secretary of Energy to enter into agreements with contractors to construct modular sized facilities to convert oil shale to alternative fuels. Under such agreements, the Federal Government may pay up to 75 percent of the design and construction costs, plus operation and maintenance costs of the modular facilities. After successful demonstration of the modular facility, the contractor may purchase the Federal interest in the modular facility either on a cash basis or by a share of the products from an expanded facility. The contractor would be eligible for Federal loan guarantees for a full sized oil shale facility after successful demonstration of a modular facility.

The Secretary of Energy is required by Title II to prepare a study of the purchase or commitment to purchase by the Federal Government, for the use of the United States, of all or a portion of the products of any alternative fuel facility, e.g., shale oil facilities, as a direct or an alternate form of Federal assistance. This study is to be completed and submitted to Congress by September 25, 1978. If Federal purchase is recommended, the Secretary of Energy is authorized to arrange for the Federal purchase.

We see the potential for and the necessity of increasing DoD involvement as an active participant in developing and implementing the evolving natural energy policy. We conclude that our

involvement is necessary to ensure adequate supplies of defense mobility fuels as natural crude production begins to lag world demand.

2.4 ALTERNATIVE SUPPLY OPTIONS

As was the case in looking at the legislative alternatives, supply options can be divided into two categories: (1) those dealing with natural petroleum, and (2) those focused on synthetic fuels.

2.4.1 Supply Options -- Natural Petroleum

2.4.1.1 Conservation

Conservation of fuel in lower priority activities is the cheapest, quickest way to provide additional fuels for essential operations during periods of scarcity. Conservation, however, when it affects military operations reaches an irreducible, but still large, minimum petroleum consumption figure. Since 1973, the DoD has reduced its energy consumption by 32 percent. The current consumption for mobility purposes of about 400,000 barrels of oil per day is thought by the Joint Chiefs of Staff and the military departments as the minimum level to maintain readiness of the current force structure.

The Department of Defense's goal for consumption of military fuels is to maintain current levels through 1985. Our intention is to encourage the use of simulators, more efficient equipment and operating procedures to reduce fuel consumption per flying hour or steaming hour. In this way, increases to total operating time may be possible and some flexibility is provided to accommodate fleet changes, deployment patterns and the like.

Though significantly increased savings of mobility fuels for any protracted length of time does not appear possible, conservation should not be dismissed from long-range planning.

As advances are made in conservation technology, conservation opportunities could increase and if the price of mobility fuel doubles between now and 1985, as DoE estimates, alternatives not presently palatable from a cost standpoint will become more attractive.

2.4.1.2 Priority Use of Available Stocks by DoD

We previously discussed the pitfalls in allocation schemes. Procedures need to be defined and DoD must learn how to articulate its priority effectively at the highest levels of Government. Even then success is not assured.

It may be possible to go further than we have discussed. We might be able to obtain legislation that would mandate a priority for DoD operations under well-defined conditions and procedures. Such legislation would incorporate the useful portions of the DPA and EPAA, tailor it specifically to fuels for mobility purposes, define those purposes in the context of the legislation (e.g., administrative motor pools would not be provided priority allocation but fighter wings engaged in a specific program of training or operation would be), identify the information needed to document the case for priorities and identify the mechanisms for allocations to the established priority scheme.

If we pursue this legislation, we recognize that the proposal has pitfalls as well as promise. Another priority system superimposed upon other more generalized authorities complicate the problem instead of resolving it. The Administration may not favor legislation that could reduce its flexibility in responding to a fuel

shortage. The DoD would be faced with the same uncertainty of a favorable decision to activate the authority as it does with the DPA and EPAA.

2.4.1.3 Stockpiling

Various stockpiles exist or are being built. Industry has its own stocks for its management purposes, about 1.2 billion barrels. DoD has war reserve stocks that are calculated to provide fuels to deployed forces in a contingency from D-Day until resupply is established. DoD also has about 14 million barrels in its tankage or in the supply pipeline to support normal peacetime operations. The Strategic Petroleum Reserve (SPR), is being established to provide a source of crude petroleum in the event of disruption to our overseas sources. The SPR would compliment DoD stocks in some scenarios by providing crude oil to refineries to process and ship to deployed forces.

There is no stockpile that is earmarked for DoD to use in a peacetime period of supply shortfall. DoD war reserve stocks are specifically for wartime operations. The SPR is a national stockpile, to be allocated if the need arises, across the spectrum of national needs and priorities. A supply option for DoD to consider, then, is a special, earmarked "embargo" stockpile. This could be part of the SPR (mandated through legislation) or separate from it (stored by DoD for DoD).

Additional stockpiling (either an SPR add-on or DoD controlled) would be an expensive option because storage capacity would have to be built or leased and petroleum (either crude or refined)

would have to be brought and transported to storage sites. DoD stockpiling would require Congressional approval (funds must be appropriated), could exacerbate the balance of payment problem if petroleum is purchased abroad, but would not provide ironclad assurance of its availability to DoD when the need arose. During the 1973 embargo, the DoD was requested to provide jet fuel priority war reserve stocks for commercial airlines. "Embargo" stocks would seem even easier to divert.

A variation on this alternative would be to earmark a portion of the SPR for DoD purposes. This would avoid the problems associated with increasing planned stockage levels but would not have one of the advantages from doing so -- the extra insurance of an absolute increase in the total amount of petroleum stockpiled. "How much is enough" is a question validly asked when buying additional insurance. A strong argument can be made from DoD's perspective that with a one billion barrel SPR, there are sufficient stocks for foreseeable requirements. The problem is getting some portion of the currently planned stockpile committed to DoD.

Efforts to develop this commitment are needed as a follow-on to the work of the Task Force. These efforts should be conducted in conjunction with the priority allocation work discussed above.

2.4.1.4 Fuel Specifications

It is possible to broaden the range of petroleum products that are usable in DoD mobility equipment through R&D on fuels

and propulsion systems. Ability to use a broad spectrum of fuels, without unacceptable performance degradation would be of great value in periods when the shortages (and the inadequate supplies available) must be shared by everyone. With multi-fuel engines, DoD's flexibility to acquire fuels in a tight market (when refiners do not have the resources to cater to DoD's unique requirements) will be greatly enhanced.

The Army has done considerable work in this area, largely on piston engines, the other Services lesser amounts. Development of a multi-fuel capability is a low-cost option and should be aggressively pursued.

2.4.2 Supply Options -- Synthetic Fuels

We have demonstrated that oil, refinable into DoD-usable products, can be extracted from the plentiful materials such as coal, oil shale and tar sands. This section of the report discusses these synthetic fuels.

Projected cost of fuel derived from these sources is considerably more than the present cost of natural petroleum products. As natural petroleum becomes scarce, its price will increase. As synthetic fuels are produced on a large scale, their price should decline. Over the long-term, it does not appear that the current cost disadvantage of synthetics will persist.

An important consideration is that these sources are both plentiful and domestic, hence secure. Balanced against the fast dwindling and largely foreign reserves of natural petroleum, exploitation of synthetic fuels by the DoD is an attractive alternative.

2.4.2.1 Preparations to Use Synthetic Fuels

Considerable effort is ongoing under a Navy/ DoE program to produce and refine 100,000 barrels of shale derived fuel for testing in DoD propulsion systems. This test will provide data on refining techniques, fuel specifications and engine performance, all of which will be needed if DoD is to prepare to use synthetic fuels when they are commercially available. Smaller ongoing Army and Air Force programs also exist.

2.4.2.2 Support DoD's Initiatives to Commercialize a Synthetic Fuels Industry

DoE is currently looking at a variety of approaches that will be described in the next section. DoD is not actively involved in these DoE initiatives; however, DoD could lend its support to legislation sponsored by DoE based upon the advantages to the national security inherent in a strong synthetic fuels industry.

2.4.2.3 Be an Active Partner with DoE

DoD could, after appropriate acceptance program, agree to purchase quantities of synthetically derived fuels to assist in the commercialization program. This purchase could be at the prevailing cost of natural product, or DoD could agree to pay a premium price for synfuels.

DoD could utilize the product in a variety of ways. It could blend it with natural petroleum products. DoD could use it directly in existing mobile equipment, or could trade synthetic crude with refiners for specification products. The quantity of products

DoD would guarantee to purchase could range from a token amount of 100 percent of our mobility fuel needs.

2.4.2.4 Establish a Synfuels Government-Owned, Contractor Operated (GOCO) Facility

Under this alternative, the DoD would be heavily committed. DoD would arrange all the financing, take all the risks and dispose of all the output. Conversely, it would give the DoD control over a source of fuel that would be more assured than any other alternative.

There are major policy issues attendant to this alternative, including the development by DoD of a new role normally filled by the private sector. Any one cannot escape the inevitable conclusion that if it is seen to be in the national interest to divert DoD's synfuel output, it can be done with this as with any other alternative.

In summary, domestic synthetic fuels provide a secure supply and can be made available when natural petroleum products are scare. A healthy domestic synthetic fuels industry is in the DoD's interest. The extent to which the DoD becomes involved in creating this industry must be determined by:

- Cost versus benefits to DoD.
- The role of DoD in the evolving national energy supply strategy.
- The eventual development of adequate specifications and standards for synfuel products.
- The logistic implications of relying on synfuels for a portion of all of its mobility fuel needs (e.g., impact of 100 percent U.S. synfuel reliance on NATO interoperability goals).

- o The role of synfuels for DoD in context with other supply alternatives discussed in this section.

A summary of potential synfuel candidates is presented in the following section.

2.5 SYNTHETIC MOBILITY FUEL OPTIONS

Department of Defense mobile equipment units are optimized to perform a specific mission in the most cost-effective manner. With the exception of nuclear power for selected ship applications, mission requirements limit fuels considered for mobile equipment to liquid hydrocarbons. This class of fuel provides excellent energy values per unit weight and volume coupled with acceptable logistics and energy release characteristics.

Hydrogen has a high energy value per unit weight (51,000 Btu per pound) but has a very low energy value per unit volume (29,600 Btu per gallon) and requires low temperature storage to keep it in a liquid form. These characteristics remove hydrogen at the present time from consideration as a military mobility fuel, except for a few specialized applications.

The potential sources of liquid hydrocarbons, other than petroleum, generally fall in three categories: (1) sources of liquid hydrocarbons other than petroleum resources, e.g., shale oil, heavy oil deposits and tar sands; (2) solid hydrocarbon materials, e.g., coal and (3) solid materials which contain hydrocarbons, e.g., biomass. The results of a survey of these potential sources is summarized in Table 2. Petroleum and hydrogen are included to provide reference points.

Based on all the factors evaluated, shale oil is a most attractive near and mid-term alternative source of liquid hydrocarbon fuels for military mobile equipment. The prospects of shale oil derived substitutes for natural crude products have improved through recent demonstrations of commercialization techniques. The main problems, however, continue to be institutional and environmental, and if they are not resolved coal derived liquids will start to appear more viable.

TABLE 2
ALTERNATIVE ENERGY SOURCES

SOURCE	LOCATION	ECONOMICALLY RECOVERABLE 10^9 BBLS	TIME TO 500K BBL/DAY	JET FUEL COST $/BBL. FY78 $	ENVIRONMENTAL	INSTITUTIONAL	TECHNIC.
1. Petroleum a) Conventional	World U.S.	547.8 29.5(5.4%)	-	18.19	-	-	-
b) Tertiary Recovery	U.S.	52.0	1983	33.50	MINOR	MODERATE	MINOR
2. Alternative Liquid Fuels a) Oil Shale	World U.S.	Undetermined 80-200	1989	23.00	MAJOR	MAJOR	MINOR
b) Tar Sands /Heavy Oil	World U.S.	Undetermined 2.5-5.5	1989	23.00	MODERATE	MAJOR	MINOR
c) Coal (Liquefaction)	World U.S.	2406 657(27.3%)	2000	33.00	MAJOR	MAJOR	MAJOR
d) Hydrogen	Worldwide	Unlimited	1995	22.00	MINOR	UNDETERMINED	MAJOR
e) Biomass	World U.S.	Undetermined 0.8/YR	1995	25.00	MINOR	MODERATE	MAJOR

MINOR - PROBABLY EASILY OVERCOME
MODERATE - SOME UNCERTAINTY; NEEDS ATTENTION
MAJOR - WILL PREVENT SUCCESS OF PROGRAM UNLESS SOLVED; WILL REQUIRE SIGNIFICANT EFFORT TO OVERCOME

Source: DoD Estimate

2.6 CURRENT SHALE OIL PROGRAM AND COMMERCIALIZATION ALTERNATIVES

Oil shale is a resource about which the Federal government does have significant knowledge and expertise. This expertise has been built through the years by the Bureau of Mines, the former Energy Research and Development Administration (ERDA) and more recently, by the Department of Energy (DoE).

The current DOE oil shale program is directed toward the development and demonstration of in-situ recovery technologies. This emphasis was established following the response to the Department of Interior Prototype Leasing Program in 1974 that indicated the industry had sufficient confidence in surface processing technology to procede with development. More than half of the proposed $24.6 million budget for oil shale in FY 1979 is in the support of four Western oil shale projects and one Eastern oil shale project. This program reflects DOE's view that the appropriate role of the Federal Government is to provide incentives where Government can and should stimulate and/or accelerate technology development. These programs provide a Government presence to link industry and Government together with a common goal.

The Laramie Energy Research Center is involved with in-situ technology developments. The general shale oil technology needs toward which the activities of Laramie and the National Laboratories are specifically directed include rock fragmentation and the fracturing and rubblization step, that is generally agreed to be the key for success for any in-situ technology. The current program of roughly $1 million per year at Los Alamos and Sandia Laboratories represents a blend of

theoretical analysis and practical application that should be of broad utility in developing the required technology.

Four Western oil shale contracts (Occidental, Equity, Geokenetics and Talleyfrac) are scheduled for completion by 1981. Each will proceed through commercial scale retort tests. If results are successful, scaleup to commercial operation by 1985 should be possible. Each company has suitable land for commercial operation. A different part of the total Western shale oil resource is represented by each of the contracts.

Occidental and the Rio Blanco Oil Shale Company have work proceeding both at C-a and C-b prototype lease tracts in Northwestern Colorado. The two leases represent different versions of the modified vertical in-situ technology outlined in the revised Environmental Development Plan (EDP) for each tract. With timely success in this in-situ technology effort, a production of 150,000 barrels per day could be achieved in the mid-1980's.

DoE believes that surface retorting technologies should be proved in commercial scale modules as early as possible. Under Secretary Myers stated that this is achievable by private industry if government provides appropriate incentives. DoE has initiated a project to develop a Management Plan for Oil Shale containing adequate provisions to achieve commercial scale modules.

Additional details on the current DoE oil shale program are contained in Volume II.

Government involvement in commercialization alternatives for the creation of shale oil industry are presently based on the perceived problems and needs of the potential industry. The major problems are: (1) the large amount of capital required to construct a large shale oil production facility (50,000 barrels per day plant will cost over $1 billion), (2) the high cost of products produced from shale oil, ($15 to $25 per barrel), and (3) the environmental and other permits that must be obtained, for example, about 100 separate permits are required to produce shale oil in Colorado.

The high capital cost of shale oil production and storage facilities and transportation is generally agreed to exceed the capabilities of all but the largest companies. The capitalization problem is further aggravated by uncertainty that acceptable returns on investment can be achieved due to both the high cost of salable products compared to natural petroleum products and the possibility that products derived from shale oil may not be acceptable to some consumers. Tehnological risk and environmental considerations associated with the production and refining of shale oil products further increase the uncertainity. These considerations are dependent to some extent on the processes employed.

A few of the possible options available to facilitate the formation of capital include:

- Loan guarantees (provided for in the FY 1978 Energy Research and Development Administration's (ERDA) Authorization Act).
- Guaranteed purchase price for products from shale oil (provided for in the FY 1978 ERDA Authorization Act).

- o Tax incentives for the production shale oil products (similar to the "Talmadge" amendment to the National Energy Act).

- o Government financing, in part or totally, of shale oil production facilities.

- o A mandate that crude oil refiners use a specified percent of shale oil (or more generally, synthetic crude oil) as input to their processes (refineries).

There are many other incentives and variations on those enumerated. The incentives for capital formation included possible mechanisms to provide a reasonable return on investment. The large capital requirements probably make it necessary to provide both direct assistance in capital formation, e.g., loan guarantees and government financing, and mechanisms to assure a favorable return on investment, e.g., purchase guarantees. We note that Canada has adopted a law that will subsidize the price of oil produced from Alberta tar sands. This type of subsidy might also be necessary to make possible near-term commercialization of shale oil.

The problems associated with environmental and other permits required to construct and operate shale oil production facilities are difficult to solve. The only logical approach, short of a legislated mandate that would override the permit processes (as used to construct the Alaskan oil pipeline), is a concerted action by Federal, state and local governments, in concert with the various public interest groups, to minimize the time and cost of the permit process. Short of this, the potential shale oil industry feels that a stabilizing of requirements would be a great help. A company's shale oil plan may be acceptable

based on present criteria, but they have no assurance that the criteria will not change in the future and their plan become unacceptable.

The lead time to establish a commercial shale oil industry is at least 8 to 15 years. Failure to initiate the establishment of a shale oil industry until the market price of products will assure a favorable return on investment is not commensurate with the Nation's and DoD's future needs for assured supplied of liquid hydrocarbon fuels.

Providing incentives and exploiting these commercialization alternatives is primarily a DoE responsibility. However, DoD's future operations are tied so closely to the availability of mobility fuels that close and continuing liaison must be maintained with DoE and the industry on these and other synfuel options. We have initiated this liaison and have provided for its continuance in the DoD Mobility Energy Plan structure.

Equally important are the DoD efforts to develop the fuel and engine technology necessary to use synfuels when they become available in quantity. A general strategy for DoD's RDT&E approach to synthetic fuel utilization is presented in the next section of this report.

2.7 DOD SYNTHETIC FUELS TECHNOLOGY PLANS

2.7.1 Introduction

The introduction of synthetic fuels into DoD service requires activity which can be organized toward two major objectives. The first, more immediate objective, is the achievement of capability to utilize synthetic fuels in the existing inventory, much of which has 20-40 years of remaining economic lifetime. The second objective, more distant in time, is the development of equipment designed a-priori to accept either a single synthetic fuel or, as in the case of a multifuel engine, to accept a variety of liquid hydrocarbon fuels.

The use of fuels other than liquid hydrocarbon fuels can also be considered. Such fuels differ markedly from liquid hydrocarbon fuels in volumetric (BTU/Gal) and gravimetric (BTU/lb) energy densities and thus may entail considerably different vehicle configurations from those conventionally employed. Their use may be restricted to specific vehicles where further study determines that advantages exist.

The basic premise underlying the DoD synthetic fuel technology programs is that the ultimate large scale commercialization of synthetic fuels will be sponsored by industry in cooperation, perhaps, with the DoE. Such programs are being discussed and can be optimistically expected to start delivery of substantial quantities of synthetic mobility fuels to DoD no earlier than the 1985-1987 time period. Meeting this schedule will require that prototype specifications for these fuels be developed by DoD technology studies and provided to the industry during the 1982-1983 time period.

The following sections describe the DoD and supporting Service projections of developmental programs required to meet the broad goals described below. Overall OSD R&D management will assure a minimum duplication coupled with needed responsiveness. Interoperability among Services and with allies will be a prime goal of these development efforts with resonsibilities appropriately assumed by the Services.

2.7.2 Broad DoD Goals

The goal of the DoD technology programs in the adaptation of synthetic fuels to the mobility applications of the Services. Consideration of the present mobility inventory requires that early attention be given to the definition of the fuels slate required to support the technology and test programs of DoD prior to the general distribution of these products. This slate and its variation with time, will be dictated by the nature of the Technology Base programs projected by the Services, the timing of various elements of the technology programs, the parametric variations required to support the Services varied technology investigations, and the need for close coordination between the synthetic fuel suppliers and the test program scientists.

In the process of studying the adaptation of synthetic fuels to present systems, sufficient experience will be gained to provide a basis for further long term considerations of multifuels engines.

2.7.3 Service Projections

2.7.3.1 Army

The fuel requirements for U.S. Army engines must encompass and satisfy a wide range of powerplant systems ranging from small two-cycle spark-ignition engines to large (over 1000 hp) two-cycle/ four-cycle compression-ignition engines. In addition, gas turbine engines are used in fixed/rotary wing aircraft, ground power generation systems and more recently the new main battle tank (XM-1). Although some of these powerplants have evolved from commercially available systems, their configuration has been modified to an extent which generates fuel requirements exceeding their commercial counterparts. In addition to this diversity of powerplants, the performance requirements dictated by combat operations increase the uniqueness of fuel requirements, i.e., volatility control for gasolines, storage stability, vulnerability reduction with use of fire-safe fuel, etc. The types of fuels used by U.S. Army engines are primarily diesel fuel (regular), JP-4, JP-5 and MOGAS (automative gasoline).

To accomplish the above objectives, definitive Technology Base programs need to be established, that initially address the fuel performance characteristics of these products. Following this, combustion characterization, emissions, deposits, wear and lubricant performance are needed because of fuel characteristics unknowns. The compatibility of these fuels with materials found in fuel handling systems will be investigated.

Following this phase, endurance-type durability test programs will be initiated to confirm the absence of any deleterious effects and to also provide necessary reliability and maintainability data. As part of this effort, fuel-engine-lubricant compatibility tests will be conducted to ensure the eventual acceptability of the products in question. Because of the multiplicity of powerplants selected, engines having a fuel composition criticality will be evaluated to provide a representative sampling for the total fleet. Two or possibly three U.S. Army aircraft engines will be evaluated for certification using 1000-hour endurance testing. Full-scale testing of fuel handling equipment systems will be completed using the syncrude-derived products.

The final phase will involve user acceptance fleet testing of U.S. Army equipment at selected CONUS facilities. Locations will be selected on the basis of having a high density of vehicle/aircraft systems and a cross section of operating environments.

In addition to these activities the Army RDTE program seeks to develop powerplants with the ability to operate on a multitude of fuel compositions ranging from aviation gasoline to burner/residual fuels. The activity leading to this multifuel capability is described in Chart 1.

CHART 1

MULTIFUEL ENGINE RDTE IN U.S. ARMY

1. Multifuel capability as used in U.S. Army RDTE programming documents defines the ability of a powerplant to utilize fuels other than the primary or alternate fuels without experiencing any performance degradations. The fuels in question can range from aviation gasoline (MIL-G-5572) to burner/residual fuels (VV-F-B59).

2. To this end, U.S. Army agencies have been actively pursuing programs which have been and are being structured to develop multifuel capabilities for existing and future designed powerplant systems. A brief description of these programs is as follows:

a. Under the Fuels and Lubricants RDTE program, an ongoing program is addressing the utilization of high-sulfer fuels in two-cycle diesel engines which are very fuel sulfur limited. Further, a quality fuel specification which would allow operation of compressor-ignition tactical engines on a wide range of diesel/distillate fuels.

b. Under Tank-Automative Research and Development programs, several contractual efforts are addressing the need to increase diesel engine multifuel capability via possible engine modification of by development of new fuel injector systems. In gas turbine RDTE, efforts are being directed to develop multifuel capability for the AGT-1500, the powerplant for the XM-1.

c. Under research programs being sponsored by Army Aviation Research and Development Laboratories, the multifuel capability is also being pursued in advanced combustor developmental effort. For example, under the STAFF* program the gas generators were being required to operate on JP4, JP5, JP8 and DF2 (diesel).

*Small Turbine Advanced Gas Generator

2.7.3.2 Navy

The Navy intends to develop the capability to utilize synthetic liquid hydrocarbon fuels produced from domestic fossil resources (oil shale, coal, tar sands) by the time they become commercially available in significant quantities. Fuels of primary concern are middle distillates for gas turbine, diesel and steam driven ships (e.g., DFM) and gas turbine powered ships and ship based aircraft (e.g., JP-5).

Current Technology Base programs are determining typical synthetic hydrocarbon fuel physical and chemical property relationships and the relationship between fuel properties and hardware behavior. This work will be used to address the adequacy of current fuel specifications for procurement of future Navy fuels and the impact of broadening specifications in order to increase availability and possibly hold down costs.

Analyses will be conducted to assess the impact of fuel property changes on engine performance, total fuel system and engine life cycle costs, and costs of retrofit and future changes in maintenance requirements for existing hardware. Future advanced development programs will include test and evaluation of selected fuels from commercially viable crude sources in full scale hardware. The impact of the use of these fuels on the total fuel handling and engine system will be determined.

Of specific importance to the Navy are those special fuel properties for ship based applications which provide for enhanced ship safety and reduced vulnerability.

Finally, test and evaluation programs will be conducted under operational conditions in complete systems (both ship and ship based aircraft) to qualify selected fuel types for service use.

2.7.3.3 Air Force

The Air Force has responsibility for the administration of aviation fuel specifications for the Services and, in its aircraft turbine engines, the Air Force consumes a volume of fuel which annually comprises about 60 percent of the DoD mobility fuel consumption. Therefore the Air Force transition plan for synthetic fuels will only consider those technical problems which impact on specifications for the bulk fuels used by tactical and strategic Air Force turbine engines. Considerations of Air Force ground motor vehicles and facilities will not be addressed.

The Air Force plans a three-phase program to introduce synthetic fuels into its aircraft inventory.

Phase I of the Air Force transition plan will be an RDT&E program to characterize JP-4 and JP-8 fuels produced from fossil crude sources (petroleum and synthetic) and to evaluate the effects of specification limits on cost, availability, and reliability of aircraft subsystems. The program will involve bench testing, component testing and finally full scale engine testing of selected Air Force systems. Life cycle costing using best estimates of processing costs, hardware retrofit costs, and maintenance costs will be projected as a function of the synthetic fuel specifications to determine whether small

changes in fuel specifications (and no hardware change) or larger changes in fuel limits with some limited hardware changes is most cost effective.

Phase I will continue during Phases II and III and, based on flight test data, the total program will lead to the development of a synthetic fuel specification for Air Force consumption.

Phase II of the Program will provide a safe-to-fly verification of the prototype specification. It will consist of a small number of test aircraft accumulating flying hour experience at accelerated rates. During these endurance tests detailed maintenance assessments will be made to provide assurances that the alternate fuels can be used without serious long term detriment to Air Force equipment or methods of operation. The initial effort will define an air start envelope and provide ground start assurance. Subsequently enough high time engine experience will be accumulated to reduce risk of either catastrophic failure or reduced system lifetime.

Phase III is the lead-the-force flight testing of an increasing number and variety of aircraft to accumulate statistically relevant data. The growth rate of numbers of aircraft (and types) must be closely woven into future synthetic fuel production capability. Both engine population and hours accumulated per engine must be large enough to draw statistically sound data since long-term effects such as engine hot section durability are a concern.

2.7.4 Implementation Schedules

Proposed synthetic fuel R&D program schedules for the Services are shown in Charts 2, 3, 4, and 5. These plans reflect the

disparate powerplants enumerated above and the requirement to qualify synthetic fuels of presently uncertain specification without impairing equipment operation or lifetime. The projected plans vary in level of detail and are to be considered tentative inasmuch as:

a. Some, but not all of the required funds have been programmed through 1983.

b. Arrangements for supply of fuels of variable specifications required to perform all of the tests and to determine optimum cost/ performance specifications and multifuel operating ranges have not been established.

In spite of these and other shortcomings the plans represent a vital first step toward projecting DoD test requirements for synthetic fuels.

The specific fuel requirements of the Services are shown in Table 3.

TABLE 3

FUEL REQUIREMENTS OF SERVICES R&D PROGRAM
(Barrels)

	78	79	80	81	82	83
ARMY						
MOGAS	0	25	25	238	238	9,524
JP-4	0	1,429	1,420	15,476	15,476	17,857
DFT	0	30	30	1,548	1,548	22,619
NAVY						
JP-5	20	6,400	13,800	6,200	6,200	500,000
DFM	0	31,500	91,000	83,500	65,750	10,500
AIR FORCE						
JP-4	0	300	1,900	6,625	10,000	15,000
TOTAL	20	39,684	108,175	113,587	99,212	575,500

The total DoD requirements for a slate of test fuels is shown in Table 4. These data represent the sums of quantities indicated in Table 3.

TABLE 4

COMPOSITE TEST FUEL SLATE FOR DoD PROGRAM
(Barrels)

	78	79	80	81	82	83
MOGAS	0	25	25	238	238	9,524
JP-4	0	1,729	3,329	22,101	25,476	32,857
JP-5	20	6,400	13,800	6,200	6,200	500,000
DFR	0	30	30	1,548	1,548	22,619
DFM	0	31,510	91,000	83,500	75,750	10,500
TOTAL	20	39,684	108,175	113,587	99,212	575,500

CHART 2

TRANSITION PLAN

FOR

UTILIZATION OF SYNTHETIC FUELS BY U.S. ARMY

TIME FRAME: 1979-1984

PRIMARY MOBILITY FUELS:

DIESEL FUEL

TURBINE FUEL

GASOLINE

PHASE I 1979-1980

- LABORATORY ANALYSIS
- COMBUSTOR TESTS
- SINGLE-CYLINDER ENGINE TESTS
- STORAGE STABILITY
- ELASTOMER COMPATIBILITY
- ENGINE DEPOSITS
- EMISSIONS

FUEL REQUIREMENTS (GAL)

DIESEL	2,500
TURBINE	120,000
GASOLINE	2,100

CHART 2 Cont'd)

ARMY SYNTHETIC FUEL TRANSITION PLAN

PHASE II 1981-1982

. FULL-SCALE ENGINE TESTS

. TEST FUEL HANDLING EQUIPMENT .

. ENGINE WEAR, LUBRICATION, AND PERFORMANCE

. WRITE FUEL SPECIFICATIONS

. QUALIFY AIRCRAFT ENGINES

. LIMITED FLEET TESTS

FUEL REQUIREMENTS (GAL)

DIESEL	130,000
TURBINE	1,300,000
GASOLINE	20,000

PHASE III 1983-1984

. LARGE-SCALE FLEET TESTS

. FLIGHT TESTS

. TOTAL OPERATION OF SELECTED BASES ON SYNTHETIC FUELS

REVIEW FUEL SPECIFICATIONS

FUEL REQUIREMENTS (GAL)

DIESEL	1,900,000
TURBINE	1,500,000
GASOLINE	800,000

CHART 3

NAVAL SHALE OIL TESTING PROGRAM FOR SHIPS

FUNDING CATEGORY	PROGRAM TASKS	1979	1980	1981	1982	1983	19
6.2	ANALYZE FUELS PROPERTIES, VERIFY CHEMICAL AND PHYSICAL PROPERTIES AND COMPARE WITH EXISTING SPECIFICATIONS.	$95	$23		$10		
6.2	CONDUCT TOXICOLOGY TESTS: SUPPORTING ANALYSES OF LABORATORY ANIMAL EFFECTS.	$61	$50	$45	$30	$20	
6.2	EVALUATE ENGINE AND COMPONENT DEVELOPMENT, PROVIDE FOR POSSIBLE MINOR EQUIPMENT MODIFICATION AND REDESIGN TO ENSURE OPERABILITY OF IN-SERVICE SYSTEMS WITH SHALE FUELS.	$75	$75	$100	$75		
6.2	EVALUATE COMINGLED FUELS AND INVESTIGATE ADDITIVES TO SOLVE PROBLEMS UNCOVERED DURING ENGINE TESTING.		$90	$110	$100	$100	$100
6.3	CONDUCT TOXICOLOGY TESTS ABOARD SHIP.	$60	$60	$75	$40	$20	
6.3	CONDUCT SMALL-SCALE COMBUSTOR TESTS (ASSUMES 6 DIFFERENT BOILER BURNER TYPES, 4 OR 5 DIFFERENT DIESEL COMBUSTOR TYPES AND 3 DIFFERENT GAS TURBINE COMBUSTOR TYPES INITIALLY).	260 $0	500 $400		250 $200		
6.3	CONDUCT FULL-SCALE LAND-BASED ENGINE TESTS (ASSUMES 3 DIFFERENT SYSTEMS EACH FOR BOILERS, DIESELS, AND GAS TURBINES)	30,150 $1,375	50,500 $3,400	28,500 $1,095	10,500 $415	10,500 $415	
6.3	TEST FUEL SYSTEMS COMPONENTS, TEST COMPATIBILITY AND OPERABILITY OF FUEL HANDLING AUXILIARIES.	$75	$100	$150	$175	$75	
6.4	CONDUCT SEA TRIALS.			55,000 $375	55,000 $375		
		TOTAL FUEL (bbl)	TOTAL COST (× 10³)				
	6.2	–	$ 1,164	$ 231	$ 243	$ 255	$ 215	$120	$100
	6.3	172,260	9,270	2,650	3,960	1,320	800	510	–
	6.4	110,000	750	–	–	375	375	–	–
	TOTAL COST (× 10³)	–	$11,184	$2,881	$4,203	$1,950	$1,390	$630	$100
	TOTAL FUEL (bbl)	282,260	–	31,510	91,000	83,500	65,760	10,500	–

$\left(\frac{\text{BBL}}{\text{COST IN THOUSANDS}}\right)$

CHART 4

NAVAL SHALE OIL TESTING PROGRAM FOR NAVAL AIRCRAFT

FUNDING CATEGORY	PROGRAM TASKS	1978	1979	1980	1981	1982	19[illegible]	[illegible]	1985
6.2	DETERMINE CHEMICAL COMPONENTS THAT INFLUENCE FUEL PROPERTIES, ESTABLISH STORAGE STABILITY MECHANISMS, ADDITIVE EFFECTS, MICROBIOLOGICAL AND OTHER PHYSICOCHEMICAL RELATIONSHIPS.	10 $255	$160	$176	$194	$215	[illegible]	[illegible]	[illegible]
6.2	DETERMINE EFFECTS OF FUEL PROPERTY VARIATIONS ON HARDWARE PERFORMANCE. DEVELOP NEW LABORATORY TEST TECHNIQUES THAT RELATE FUEL PROPERTIES TO ACTUAL PERFORMANCE	10 $315	$373	$420	$450	$480	$520	[illegible]	[illegible]
6.3	DEVELOP ALTERNATE TEST PROCEDURES TO QUALIFY NEW FUELS FOR NAVY USE, MINIMIZING FULL-SCALE ENGINE TESTING.	$300	$400	600 $800	200 $500	200 $550	200 [illegible]	[illegible]	[illegible]
6.3	CONDUCT ENGINE QUALIFICATION STUDIES (150 HOUR, SEA LEVEL/ALTITUDE, COLD STARTS); TF 30 ENGINE (F-14), TF 34 ENGINE (S3A), TF 41 ENGINE (A-7A).		6,000 $800	3,000 $620	6,000 $800				
6.3	FLIGHT TEST (300 HOURS) F-14 AND S3A AIRCRAFT. FUEL FOR F-14 WILL HAVE BEEN QUALIFIED BY 150 HOUR QUALIFICATION TEST; FUEL FOR S3A WILL HAVE BEEN QUALIFIED BY ALTERNATE TEST PROCEDURES			10,000 $1,000		6,000 $1,000			
6.4/6.6	LAND-BASED SQUADRON: CONDUCT STUDIES OF FUEL HANDLING, COALESCERS, TANKAGE, ETC.; ENGINE INSPECTIONS/STORAGE STABILITY MONITORED						500,000 $178	[illegible]	
6.4/6.6	AIRCRAFT QUALIFICATION: CONDUCT FUEL HANDLING STUDIES, COALESCER PERFORMANCE STUDIES AT SEA CONDITIONS; CLOSE INSPECTION OF FUEL CLEANLINESS AND WATER REMOVAL; COPPER REACTION.							500,000 $194	[illegible]

	TOTAL FUEL (BBL)	TOTAL COST (× 10⁶)							
6.2	620	$ 8,278	$560	$ 503	$ 596	$ 644	$ 695	$ 770	$ [illegible]	$ [illegible]
6.3	32,200	6,444	300	1,200	2,420	1,300	1,550	600	[illegible]	[illegible]
6.4/6.6	1,000,000	550	–	–	–	–	–	178	[illegible]	[illegible]
STORAGE/SHIPPING	–	6,601	–	22	63	10	86	3,100	[illegible]	
TOTAL COST (× 10⁶)		$21,149	$860	$1,725	$3,079	$1,954	$2,331	$4,048	$[illegible]	[illegible]
TOTAL FUEL (BBL)	1,032,820	–	20	6,500	13,800	6,200	6,200	[illegible]	[illegible]	

$$\left(\frac{\text{BBL}}{\text{COST IN THOUSANDS}}\right)$$

CHART 5

AIR FORCE SYNTHETIC FUELS TRANSITION PLAN
($1000's)

	1978	1979	1980	1981	1982	1983	1984
PHASE I - Technology and Engine Test							
1. Fuels Test Program Explore Sources, Costs, Properties Specification Sensitivity	150	1000	850				
2. Physical, Chemical Properties	010	020	020	020	020	020	
3. Toxicity and Fuel Handling		100	100	100	100	100	
4. Mainburner Turbine Test J-57, J-79, F-100, TF-33, TF-39, J-85		1000	2500				
5. Augmentors			1750				
6. APU's			500	1000			
7. Fuel Systems			500	500			
8. Advanced Engines Interim Fuel Spec. Engine Qualification Test			1250	2000 2000	2000		
PHASE II - Flight Assurance*							
1. Test Stand* Safe to Fly, Flight Test					35		
2. Durability Flight Test*					150	125	
3. Optional Safe to Fly*					25		
PHASE III - Lead the Force Testing**							
1. ATC - T-38 Utilization						xx	xx
2. TAC - F-4 Utilization (optional)						xx	xx

*Phase II Fuel Costs Not Shown

**Phase III Costs Not Available

SUMMARY

Funds ($1000)	160	2120	7470	5625	2300	245	
Fuel (Barrels, w/o Phase III)	0	300	1900	6625	10000	3000	
Engine Hrs. High Time				150	280	460	
Engine Hrs. Total Hrs.				450	1000	1720	

CHAPTER 3

CONCLUSIONS AND RECOMMENDATIONS

3.1 FINDINGS

In this section are listed findings of the Task Force.

3.1.1 Petroleum Shortages

Significant shortages of natural petroleum fuels for U.S. needs will probably occur in the last 1980's or 1990's. To sustain the force structure and the force readiness necessary to national defense, petroleum crude production must be augmented by that time, with alternative sources of mobility fuels.

3.1.2 Foreign Dependence

U.S. dependency on foreign sources is not likely to decrease in the near-term. U.S. domestic production of natural crude production has passed its maximum in 1970 and will not appreciably grow even under assumptions of favorable Government action and new technology. It is assumed that growth in U.S. consumption of petroleum must be supported by imports or substitutes.

3.1.3 Defense Petroleum Requirements

DoD will depend on petroleum or substitute liquid hydrocarbon fuels to meet its mobility energy requirements for the foreseeable future.

The total direct U.S. military peacetime petroleum consumption is about 2.5 percent of total U.S. consumption or less than 5 percent of 1977 domestic production. Of this total DoD consumption

of 175 million barrels annually, 85 percent is used by vehicles as a mobility fuel. This amounts to about 400,000 barrels per day.

3.1.4 Priority Allocations

The DoD presently has only two means of obtaining priority among U.S. users for its fuel supplies: the Defense Production Act, and the allocation under the Emergency Petroleum Allocation Act of 1973 which at the present time is scheduled to run out in 1978. During periods of war, it can be assumed that national defense may obtain priority; however, during peacetime we conclude that DoD will be hard pressed to compete for energy resources with the other sectors of the national economy.

3.1.5 Natural to Synthetic Crude Oil Transition

DoD must plan an orderly transition from natural to synthetic oil products and other fuels in the time period (1985-2010) to ensure that its mobility fuel needs can be satisfied through greater reliance on developable domestic sources. To achieve this goal DoD must vigorously pursue extensive R&D; and planning including:

- development of multifuel engines compatible with synthetic fuels
- development of propulsion systems for non-conventional fuels
- development of specifications to guide synthetic fuels development by DoE
- investigating the logistics required for worldwide use of synthetic fuels by the military, and
- development of contingency planning for the transition from conventional fuels to synthetic liquid hydrocarbon mobility fuels

3.1.6 Shale-Derived Fuels, A Most Attractive Alternative

It is the conclusion of the Task Force that at the present time, shale-derived fuels are a most attractive alternative for military mobility needs. The two most abundant sources of domestic synthetic fuels are coal and oil shale. Of the two, the technology for producing liquid fuels from oil shale leads that of coal and both are significantly ahead of technologies associated with other alternative sources such as hydrogen, biomass and solar. The main problems with oil shale, however, continue to be institutional and environmental, and if they are not solved in the near future coal derived liquids will start to appear more viable.

3.2 RECOMMENDATION - MOBILITY FUELS ACTION PLAN

Based upon the findings listed above, the Task Force recommends that DoD develop a comprehensive Mobility Fuels Action Plan.

The skeletal framework, including a suggested management structure and future activities, is described in the next three sections.

3.2.1 Overview

The Shale Oil Task Force has indicated an urgent need for a DoD management and program plan directed towards meeting its future mobility fuel requirements. Essential ingredients of the plan are listed below.

1. An annual statement is needed of the DoD's current and projected ten-year mobility fuel requirements, by quantity and type.

2. The DoD needs to make specific requests of the DoE to meet its future mobility fuel needs from secure sources. This request will be based upon a formal DoD/DoE secretarial level Memorandum of Understanding that binds both agencies to work together to pursue more active programs to meet the DoD's future mobility fuel needs as required. A briefing will be provided to the President or the National Security Council, jointly by the Secretary of Defense and the Secretary of Energy, to describe joint policy agreements and programs in order to formalize administration defense mobility fuels policy at the highest levels.

3. A fuel distribution system will be identified which is more responsive to the U.S. Worldwide force structure requirements and changing fuel supplies. The need for additional regulatory agreements

will be determined for allocation of existing assets and for the development and expansion of productive capacity and supply of defense mobility fuels.

4. The DoD will plan to shift from dependence upon natural petroleum products by developing a capability to use the products of the emerging domestic synthetic liquid hydrocarbon fuel industry in the longer term (1985-2010). To achieve this objective, the following RDT&E tasks will be pursued aggressively:

- o Develop adequate fuel specifications and fuel testing methods for a large slate of military fuels.
- o Pursue test and evaluation programs for synthetic fuels.
- o In the longer term, develop engines with multifuel capabilities.

5. The DoD will develop management techniques and plans to (a) consider future mobility fuel issues during the weapon systems acquisition process (DSARC interface), (b) foster an industrial base to support future DoD mobility fuel/engine acquisition requirements and (c) establish the DoD as an informed customer for synthetic fuels.

3.2.2 Proposed Assignments

The following responsibilities will be assigned as follows:

- o The Deputy Secretary of Defense will continue to be the approving authority for major policy matters related to the Defense Mobility Fuels Program. The Defense Shale Oil Policy Steering Group will be disbanded, however, the Deputy Secretary of Defense will have available for consultation the members of the disbanded Steering Group with additional representation from ASD(PA&D) and ASD(ISA).

- The Chairman, Joint Chiefs of Staff will provide an annual update of DoD's current and projected 10-year mobility fuel requirements. This statement of requirements will include an assessment of DoD's ability to secure adequate supplies for peacetime operation and to sustain adequate war reserve stockage.

- The Under Secretary of Defense for Research and Engineering will be responsible for proposing policy and development programs on matters relating to mobility fuels RDT&E.

- The Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) will be responsible for proposing policy and programs on matters pertaining to logistical, fuel allocation and regulatory matters. He will serve as the primary focal point with the Department of Energy for matters relating to Defense mobility fuel requirements.

3.2.3 Suggested Management Structure

The above responsibilities are assigned to the civilian officials and will be carried out by them. The Task Force suggests the use of the following combination of existing and newly created work groups which is designed to facilitate management and performance of assigned tasks in an efficient and timely manner while preserving the functional prerogatives of the participants.

- The Defense Energy Policy Council (DEPC) should propose policy and programs on matters pertaining to operational, fuel allocation, and regulatory matters.

- The Defense Energy Action Group (DEAG) should plan and coordinate DoD-wide mobility fuels efforts pertaining to operation, fuel allocation, and regulatory matters.

- The Deputy Under Secretary of Defense for Acquisition Policy should establish synthetic fuel specifications and review the acquisition of new weapons system fuel compatibility with supply (DSARC interface).

- o A Defense Mobility Fuels RDT&E Policy Council, chaired by the Deputy Under Secretary of Defense for Research and Advanced Technology should be established. The Council will propose policy for all internal DoD and interagency matters relating to mobility fuels RDT&E. Membership should consist of representatives from OUSDRE and a representative appointed by each Service, OASD(MRA&L) and the DLA.

- o A Defense Mobility Fuels RDT&E Action Group should be established to develop plans for, and to coordinate, all RDT&E efforts for mobility fuels in accordance with policy established by higher authority and in response to Service needs. The RDT&E Action Group should be chaired by the Assistant for Research to the DUSDRE(R&AT) and should consist of representatives from OUSDRE and a representative appointed by each Service, the OASD(MRA&L) and the DLA. Associate membership will be extended to a representative from each agency with which the group has joint programs (initially the DoE and NASA).

- o The Defense Synthetic Fuels Steering Group (DSFSG) will be disbanded. The DSFSG is an informal group with members from the three Services, the Defense Fuel Supply Center (DFSC) and other Government agencies active in the synthetic fuels field. This group was formed in response to an ASD (I&L) request of 27 February 1976 that the Navy serve as the focal point and coordinator of DoD synthetic fuels efforts. The DSFSG will be superseded by the Defense Mobility Fuels RDT&E Action Group.

3.2.4 Proposed RDT&E Action Group Activities

The Defense Mobility Fuels RDT&E Action Group should; (a) establish working groups, as required, to perform program planning and coordination tasks (b) establish mechanisms to ensure adequate information exchange and preclude unwarranted duplication of efforts within the DoD and between the DoD and other agencies for mobility fuels RDT&E matters, (c) assign the task of procuring test quantities of fuels for RDT&E programs planned by the Action Group,

(d) inform for prime-mover development and acquisition activities in a timely manner of implications for their future efforts that are derived from the Group's fuels RDT&E program activities, and (e) report to the Defense Mobility Fuels RDT&E Policy Council by 1 November 1978 with a coordinated assignment for lead DoD component responsibility for mobility fuels technology. Comments on lead service assignments should be solicited from the Services and DLA and presented to the Policy Group in a decision format.

After program plans have been developed and approved, tasks to be performed by individual Services and agencies should be funded and managed through normal channels.

Attachment #1

DoD SHALE OIL TASK FORCE CHARTER

DEFENSE TASK FORCE ON SHALE OIL EXPLOITATION, DEVELOPMENTAL, ECONOMIC AND INDUSTRIAL CONSIDERATIONS

KNOWN AS DEFENSE SHALE OIL TASK FORCE

Background

The Deputy Secretary of Defense, Mr. Charles Duncan, asked for the establishment of the Task Force at a meeting on 17 December 1977.

The need for the Task Force was precipitated by a need for decisions in the immediate future on the appropriate actions to be taken by the Secretary of Defense to ensure that:

1. The exploitation of shale oil is appropriately considered as a candidate for the synthetic fuel needs of DoD.

2. The advantages/disadvantages of shale oil are delineated within the context of other alternatives to meeting DoD's fuel oil needs--from today into the predictable future.

3. The necessary (if any) modifications to mobile equipment to allow the use of shale-derived fuels are specified.

4. The data used to describe the supply/demand situation of DoD and, as applicable, the United States regarding fuel oil and alternative sources are consistent with official United States data, are those used by DOE and are credible to the greatest possible extent.

A number of relevant studies and investigations have been completed within the last five years. The latest briefing of the Armed Forces Policy Council on Energy was given by the JCS in December 1977. It was this briefing which led to subsequent actions including setting up this Task Group.

Purpose

The Defense Shale Oil Task Force, an informal group, has been tasked to provide recommendations and comments as soon as possible on the subjects

identified for SecDef action in the Background section. The Defense Shale Oil Task Force is to report to the Defense Shale Oil Steering Group also set up by Mr. Duncan on 17 December 1977. The Steering Group, chaired by Mr. Duncan, has as members: Dr. Perry, Dr. Dinneen, LTG W. W. Vaughan, Dr. White, Dr. Mann, Dr. Martin, Dr. Davis, Mr. Church and Mr. Marienthal. The first meeting of the Steering Group at which the Task Force is to report will be held in the latter part of January 1978.

Objectives

The primary objective of the Task Force is to address the potential use of shale oil as a synthetic fuel to be used by DoD as an alternative to crude oil based fuels. Near-term, mid-term and long-term aspects will be appropriately and separately outlined.

The Task Force will direct its attention to the subjects for possible SecDef action as identified in the Background section. In so doing, it will address:

1. The technical uncertainties attendant upon shale oil exploitation including:

   a. Mining methods, e.g., pit mining, in situ mining, room-and-pillar mining, above-ground extraction, etc.

   b. Water requirements and/or problems associated with shale oil processing.

   c. Refining, retorting, and distillation processes.

2. Alternatives to shale oil for synthetic fuels with emphasis on comparative economic, environmental and timing considerations.

3. Industrial considerations including:

   a. The supporting role of industry to DoD (and the inverse).

   b. The sizing of economically viable refining shale oil production facilities.

   c. The advantages/disadvantages of DoD-owned or financed shale oil refining facilities.

4. Research and development on new propulsion, aerodynamic and other aircraft modifications to permit the use of alternative fuels other than liquid fuels: the equivalent R&D relative to other military vehicles (ships, trucks, etc.).

5. The characteristics of shale oil-derived fuel as relative to its use in DoD vehicles.

6. The mutually interdependent roles of DoD and DoE with emphasis on DoD needs for DoE support.

This Task Force will not address the general subject of energy for DoD. It will address topics other than shale oil only as they relate to placing the possible use of shale oil in the correct context.

Guidance

Existing policies, regulations and capabilities of DoD and other government organizations will be utilized whenever possible in accomplishing the mission of the Group. Members of the Group should utilize the existing organizations wherever possible in accomplishing assigned and agreed upon tasks relative to Group activity.

Administration

Meetings of the Defense Shale Oil Task Force will be called by the Chairperson. Preparation and distribution of meeting minutes will be the responsibility of the Executive Secretary. Distribution of the minutes to the group members will be accomplished within one week after the conclusion of each meeting. Other reports will be prepared and published as required and in a manner deemed the most appropriate by members of the group.

Duration and Membership

The Task Force should plan on meeting its objectives and making its recommendations within 90 days of its first meeting.

Membership was suggested at the OSD meeting on shale oil held on 17 December 1977. A membership list is provided separately. Officers are:

Dr. Ruth M. Davis: Chairperson
Mr. George Marrienthal: Deputy Chairperson
Dr. George Gamota: Executive Secretary

Attachment #1

SCENARIO FOR ACTION MEMORANDUM

THE DEPUTY SECRETARY OF DEFENSE
WASHINGTON, D. C. 20301

MAR 28 1978

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
UNDER SECRETARY OF DEFENSE FOR RESEARCH & ENGINEERING
ASSISTANT SECRETARY OF DEFENSE (ISA)
ASSISTANT SECRETARY OF DEFENSE (MRA&L)
ASSISTANT SECRETARY OF DEFENSE (PA&E)

SUBJECT: Department of Defense Assignments in Support of the Military Fuels for Mobility Action Plan

I approved the "Scenario for Action" (attached) which was proposed by the DoD Shale Oil Task Force at the 30 January DoD Shale Oil Policy Steering Group meeting. These activities are vital to the future well-being of the nation and national security and require our immediate and concentrated attention. The Secretary of Defense has endorsed the proposed course of action.

The following offices are assigned the actions below which are keyed to the Task Force's "Scenario for Action". Results will be coordinated with the Task Force and provided to the DoD Policy Steering Group for approval.

- Assistant Secretary of Defense (International Security Affairs) and Assistant Secretary of Defense (Program Analysis and Evaluation) will provide a clear statement of DoD's mobility fuel needs including international considerations.

- Chairman and Cochairman of the Shale Oil Task Force and the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics), in coordination with the Assistant Secretary of Energy (Energy Technology) of DoE, will draft a proposed secretarial-level agreement between DoD and DoE which delineates responsibilities and roles. They will also draft a memorandum of understanding to cover DoE's sponsorship and continuance of their fuel projects & projects in order to meet DoD requirements.

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- The DoD Shale Oil Task Force will draft a specific request to DoE aimed at meeting DoD's mobility fuel needs from alternate sources (other than petroleum).

- Assistant Secretary of the Army (Research, Development and Acquisition), Assistant Secretary of the Navy (Research, Engineering and Systems), and Assistant Secretary of the Air Force (Research, Development and Logistics) in coordination with Assistant Secretary of Energy (Energy Technology) will highlight for action commercialization projects in other than shale oil synthetic fuel areas.

- Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics), in conjunction with Assistant Secretary of the Navy (Research, Engineering and Systems), Assistant Secretary of the Air Force (Research, Development and Logistics) and Deputy Under Secretary of Defense for Research and Engineering (Acquisition Policy), will ask DoE to:

  - Request industry to propose against a DoD timetable for early production facilities to meet DoD longer term needs of about 300,000 bbl/day.

  - Prepare a package of financial incentives, policy changes and Government actions that will provide commercial synthetic military fuel supplies from shale oil, coal and tar sands.

- Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) and Deputy Under Secretary of Defense for Research and Engineering (Acquisition Policy), in coordination with DoE, will work out a framework for possible invocation of Titles I and III of the Defense Production Act for allocation of existing assets and for expansion of productive capacity and supply for synthetics.

- Defense Logistics Agency, in conjunction with Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) and in coordination with DoE, will develop agreed-upon allocation and regulatory actions to be taken by DoE in support of DoD's mobility fuel requirements.

- Under Secretary of Defense for Research and Engineering, in conjunction with Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) and in coordination with Assistant Secretary of Energy (Energy Technology), will be responsible for financial planning and programming with budgetary requests beginning in FY 1979. Subsequent interaction with the President, Congress and OMB is essential in this planning.

Finally, it should be noted that DoD has responsibilities as a cust[illegible] for military fuels which are outside of DoE's mission. Action plans must be developed to meet these responsibilities:

- o Assistant Secretary of the Army (Research, Development and Acquisition), Assistant Secretary of the Navy (Re[illegible], Engineering and Systems) and Assistant Secretary of the Air Force (Research, Development and Logistics) will propose coordinated R&D activities to develop multi-fuel engines.

- o Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology) will propose R&D activities to develop propulsion units utilizing other than conventional liquid fuels.

- o Defense Synthetic Fuels Steering Group will develop adequate fuel specifications and fuel testing methods for a large slate of military fuels.

- o Defense Logistics Agency will develop a fuel distribution system in support of the U.S. world wide force structure which match changing fuel supplies and requirements.

- o Assistant Secretary of the Air Force (Research, Development and Logistics) and Assistant Secretary of the Navy (Research, Engineering and Systems) will be responsible for contingency planning for the transition from petroleum to synthetic fuels.

The suspense date for submission to the DoD Shale Oil Task Force[illegible], Dr. Ruth M. Davis, of preliminary results of assigned actions is five days subsequent to the date of this memorandum.

Attachment

cc:
Under Secretary of Energy, DoE
Assistant Secretary of Defense (C)
General Counsel

SCENARIO FOR ACTION

DoD URGENTLY NEEDS AN ENERGY PLAN DIRECTED TOWARDS MEETING ITS MOBILITY REQUIREMENTS. THE IMPORTANT INGREDIENTS OF THE PLAN ARE:

(A) (C) 1. ACTIONS BASED ON RECOGNITION THAT DoD'S MOBILITY REQUIREMENTS FOR THE NEXT 25-35 YEARS ASSUME A LIQUID HYDROCARBON FUEL ENVIRONMENT.

→ (A) 2. A CLEAR STATEMENT OF DoD'S MOBILITY FUEL NEEDS:

- EXTRAPOLATED FROM THE 5 YEARS OF AVAILABLE FUEL CONSUMPTION DATA.
- ADDRESSING BOTH CONTINUING PEACETIME AND WARTIME NEEDS.
- CONTAINING "MINIMUM" LEVELS REQUIRING GUARANTEED FUEL ALLOCATIONS, AND
- CONTAINING ANALYSES OF THE EFFECT OF MUCH HIGHER FUEL PRICES ON DEFENSE PROGRAMS AND BUDGETS.

(A) (C) 3. POLICY ENUNCIATED BY THE PRESIDENT THAT DoD'S MOBILITY FUEL NEEDS NECESSITATE PRIORITIES IN FUEL PRODUCTION AND ALLOCATION WHICH DoE/DoD SHOULD JOINTLY DETERMINE.

THIS WILL SERVE TO NOTIFY OMB OF FOLLOW-ON BUDGETARY ACTIONS.
(DoE CONCURS)

→ (A) 4. A SECRETARIAL-LEVEL AGREEMENT BETWEEN DoE AND DoD DELINEATING RESPONSIBILITIES AND DEFINING DoE'S SUPPORTING ROLE TO DoD.
(DoE CONCURS)

KEY: (C) = CONCURRENCE

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SCENARIO FOR ACTION (CON'T)

INGREDIENTS OF THE MOBILITY ENERGY PLAN (CON'T)

(C) 5. A RECOGNIZED INABILITY TO OBTAIN ANY ASSURANCE THAT DoD'S FUEL NEEDS CAN BE MET FROM PETROLEUM SOURCES.

→ (A) 6. A DECISION THAT DoD MUST MAKE SPECIFIC REQUESTS OF DoE TO MEET DoD'S FUEL NEEDS FROM ALTERNATE SOURCES TO PETROLEUM. (DoE IS AWAITING SUCH REQUESTS.)

(A) 7. A DECISION BY DoD AND DoE THAT BOTH AGENCIES TOGETHER NEED TO ADOPT MORE ACTIVE PROGRAMS TO MEET DoD'S MOBILITY FUEL NEEDS (N.B.: DoE CONCURS).

→ (A) A. DoE WILL SPONSOR AND CONTINUE THEIR FUEL PRODUCTION PROJECTS BEYOND DoE'S PREVIOUS "BRING TO COMMERCIALIZATION" PROJECT TERMINATION POINT IN ORDER TO MEET DoD REQUIREMENTS. (DoE CONCURS)

(C) B. DoD SHOULD NOT (1) BE IN THE 'FUEL OIL BUSINESS" OR (2) PURSUE INDEPENDENTLY OF DoE ANY FUEL PRODUCTION DEVELOPMENTAL PROJECTS.

(C) C. DoD AND DoE BELIEVE THAT INDUSTRY LEFT TO ITSELF WILL NOT DEVELOP ALTERNATE FUEL PRODUCTION CAPABILITIES ADEQUATE TO SATISFY DoD NEEDS.

D. DoD AS A MAJOR FUEL "CUSTOMER" WILL SERVE AS IMPETUS TO DoE'S FUEL PRODUCTION DEVELOPMENT PROGRAMS.

SCENARIO FOR ACTION (CON'T)

INGREDIENTS OF THE MOBILITY ENERGY PLAN (CON'T)

(A) 8. SHALE OIL IS PRESENTLY A MOST "ATTRACTIVE" ALTERNATE FUEL SOURCE FOR MOBILITY REQUIREMENTS.

- IT MATCHES DoD'S FUEL SPECIFICATIONS MOST EASILY.
- IT IS PRIMARILY ON GOVERNMENT OWNED LAND IN THE USA.
- IT HAS LARGE RECOVERABLE SOURCES.

→ (A) 9. DoD SHOULD NOT, AT THIS EARLY STAGE, PLACE ITS ENTIRE DEPENDENCE ON SHALE OIL. THERE ARE TOO MANY ATTENDANT UNCERTAINTIES. DoD SHOULD REQUEST DoE TO PURSUE COMMERCIALIZATION PROJECTS IN OTHER FUEL AREAS, E.G., HEAVY OIL AND COAL LIQUEFACTION. FURTHER, WE SHOULD CONTINUE TO DRIVE NATIONAL ENERGY STRATEGIES WHICH REDUCE DEMAND FOR (AND CONSUMPTION OF) LIQUID HYDROCARBONS.

→ (A) 10. DoD SHOULD ASK DoE - WITH ACTIVE DoD PARTICIPATION - TO REQUEST [illegible] TO PROPOSE AGAINST A DoD TIME TABLE:

A. EARLY PRODUCTION FACILITIES TO MEET IN THE LONGER TERM DoD'S NEEDS (5[illegible],000 BBL/DAY) WITHOUT RESTRICTING PROPOSALS TO SHALE OIL.

B. A PACKAGE OF FINANCIAL INCENTIVES, POLICY CHANGES AND GOVERNMENT ACTIONS THAT WILL PROVIDE COMMERCIAL SYNTHETIC MILITARY FUEL SUPPLIES FROM SHALE OIL, [illegible] TAX LANDS.

(DoE CONCUR)

SCENARIO FOR ACTION (CON'T)

INGREDIENTS OF THE MOBILITY ENERGY PLAN (CON'T)

(A) 11. DoD IN CONJUNCTION WITH DoE SHOULD WORK OUT PLANS FOR INVOKING THE DEFENSE PRODUCTION ACT AS A MANAGERIAL MECHANISM FOR MEETING DoD'S MOBILITY FUEL NEEDS.

(A) 12. DoD AND DoE SHOULD DEVELOP AGREED-UPON ALLOCATION AND REGULATORY ACTIONS TO BE TAKEN BY DoE IN SUPPORT OF DoD'S MOBILITY REQUIREMENTS.

(A) 13. DoD HAS RESPONSIBILITIES AS A CUSTOMER FOR MILITARY FUELS WHICH ARE OUTSIDE DoE'S MISSION. ACTION PLANS FOR MEETING THESE RESPONSIBILITIES MUST BE DEVELOPED. THEY INCLUDE:

A. R&D TO DEVELOP MULTI-FUEL ENGINES.

B. R&D TO DEVELOP PROPULSION UNITS UTILIZING OTHER THAN CONVENTIONAL LIQUID FUELS.

C. DEVELOPMENT OF ADEQUATE FUEL SPECIFICATIONS AND FUEL TESTING METHODS FOR A LARGE SLATE OF MILITARY FUELS.

D. FUEL DISTRIBUTION MEANS IN SUPPORT OF US WORLD-WIDE FORCE STRUCTURE WHICH MATCH CHANGING FUEL SUPPLIES.

E. CONTINGENCY PLANNING FOR THE TRANSITION FROM PETROLEUM TO SYNTHETIC FUELS.

SCENARIO FOR ACTION (CON'T)

INGREDIENTS OF THE MOBILITY ENERGY PLAN (CON'T)

(A) 14. FINANCIAL PLANNING WITH BUDGETARY REQUESTS BEGINNING IN FY 79 AND DEVELOPED JOINTLY BY DoD AND DoE ARE URGENTLY NEEDED TO PRECLUDE DoD VULNERABILITY TO DWINDLING FUEL SUPPLIES.

INTERACTION WITH THE PRESIDENT, CONGRESS AND OMB IS ESSENTIAL.

15. THE PLAN MUST RECOGNIZE THAT DoD IS ONLY PART OF A COMPLEX ENERGY ENVIRONMENT AND THAT PRIORITIES IN FUEL ALLOCATION WILL BE MADE ON A NATIONAL BASIS.

DoD'S POSITION IS STRENGTHENED TO THE EXTENT THAT ITS FUEL REQUIREMENTS FOR MOBILITY ARE CONSIDERED SEPARATELY FROM ITS TOTAL ENERGY REQUIREMENTS

AND

ITS MOBILITY FUEL REQUIREMENTS ARE DIRECTLY COUPLED TO ITS MILITARY FORCE STRUCTURE AND CAPABILITY AND RELATED TO NATIONAL SECURITY.

Attachment #3

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE DEPARTMENT OF DEFENSE
AND
THE DEPARTMENT OF ENERGY
ON THE
SYNTHETIC MOBILITY FUELS PROGRAM

I. PURPOSE

This Memorandum of Understanding provides for the conduct of cooperative activities between the Department of Defense (DoD) and the Department of Energy (DoE) to assure the future availability of energy sources to meet fuel requirements for defense mobility. It provides for a cooperative program between the DoD and DoE to identify and to develop assured liquid hydrocarbon fuel sources.

This is a subordinate agreement to the Memorandum of Understanding between DoD and DoE dated

II. SCOPE

The cooperative synthetic fuel program will include all liquid hydrocarbon fuels suitable for use in military mobile equipment. The initial emphasis of this program will be directed toward the commercialization of a shale oil industry capable of producing refined products that meet the test program and production specifications established by DoD.

The initial effort will be the preparation of a program plan for research, development, demonstration, production, and utilization of synthetic fuels. This plan will be based on the utilization of private productive capacity and capabilities to the maximum practical extent. Current cooperative efforts related to synthetic fuels development between DoD and DoE will be incorporated into the plan. The program plan will preserve the respective responsibilities of DoD and DoE.

DoE has responsibility for developing sources of synthetic fuels and DoD has responsibility for developing the capability to use synthetic fuels in DoD mobile equipment. DoD may procure synthetic fuels for its use, which could provide an incentive for further development of production capabilities for a synthetic fuels by private industry.

III. IMPLEMENTATION

The synthetic fuels program will be implemented through a Program Coordinator in each department, designated by the Secretary of Defense and the Secretary of Energy. The Program Coordinators will be responsible for liaison between the two agencies and will propose a cooperative synthetic fuels program plan and implementation schedule. The Secretary of Defense and the Secretary of Energy each will designate a Program Coordinator within 90 days of the date of execution of this memorandum.

A. The program plan will reflect DoE responsibilities to:

1. Determine the technological status and commercial viability of alternatives for the production, transportation, and refining of shale oil.

2. Determine the impact of the potential requirement for shale oil products or the broad objective of establishing a shale oil industry capable of meeting the needs of both DoD and the private sector.

3. Determine what additional incentives will be needed to establish a responsive shale oil industry.

4. Produce and refine shale oil in accordance with DoD specifications for testing in military equipment.

5. Establish target dates, starting in 1985, for the production of shale oil to be used for military liquid hydrocarbon fuels.

6. Incorporate provisions for DoD testing of other alternative liquid hydrocarbon fuels with projected economics and commercial availability consistent with DoD needs.

B. The program plan will reflect DoD responsibilities to:

1. Prepare specifications for synthetic fuels suitable for test in military mobile equipment.

2. Procure and test synthetic fuels in military mobile equipment.

3. Determine required synthetic fuel characteristics for operation in military equipment.

4. Determine essential and desirable modifications to military engines required to operate when fueled by synthetic fuels.

5. Determine cost of modifications and industry's capability to incorporate such modifications.

6. Establish the characteristics and costs of DoD logistics system required to store and distribute synthetic fuels.

C. Each phase of the plan will incorporate provisions that:

1. Establish decision milestones during each phase to permit adjustments in the overall plan to reflect information from parallel DoD technology and test programs, or from other sources.

2. Evaluate financial incentives and regulatory options, to include loan guarantees, tax incentives, minimum prices, and assured purchase quantities.

IV. AMENDMENT AND TERMINATION

A. This Memorandum of Understanding shall be reviewed annually by DoE and DoD to determine whether it should be continued, modified, or terminated.

B. This Memorandum of Understanding may be terminated or amended by mutual agreement of DoE and DoD. Normally, a minimum of 180 days advance notice of proposed termination will be provided.

V. EFFECTIVE DATE

This Memorandum of Understanding is effective when signed by both departments.

James R. Schlesinger
Secretary
Department of Energy

Date

Harold Brown
Secretary
Department of Defense

Date